RF TEST REPORT

Applicant	Qboid,Inc.
FCC ID	2AYQM-M2W01
Product	Handheld 3D Dimensioning Terminal
Brand	Qboid
Model	Perceptor M2
Report No.	R2111A0948-R1V2
Issue Date	March 7, 2022

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2020)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Prepared by: Peng Tao | *Approved by: Kai Xu*

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Version	Revision description	Issue Date
Rev.0	Initial issue of report.	February 9, 2022
Rev.1	Update description.	March 4, 2022
Rev.2	Update description.	March 7, 2022
Note: This revised report (Report No. R2111A0948-R1V2) supersedes and replaces the previously issued report (Report No. R2111A0948-R1V1). Please discard or destroy the previously issued report and dispose of it accordingly.		

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Summary of measurement results

Number	Test Case	Clause in FCC rules	Verdict
1	Maximum output power	15.247(b)(3)	PASS
2	6 dB bandwidth	15.247(a)(2)	PASS
3	Power spectral density	15.247(e)	PASS
4	Band Edge	15.247(d)	PASS
5	Spurious RF Conducted Emissions	15.247(d)	PASS
6	Unwanted Emissions	15.247(d),15.205,15.209	PASS
7	Conducted Emissions	15.207	PASS
Date of Testing: December 22, 2021 and January 19, 2022 Date of Sample Received: November 19, 2021			
Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

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1. Test Laboratory

1.1. Notes of the test report

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1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3. Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City:	Shanghai
Post code:	201201
Country:	P. R. China
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E-mail:	xukai@ta-shanghai.com

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2. General Description of Equipment under Test

2.1. Applicant and Manufacturer Information

Applicant	Qboid,Inc.
Applicant address	118 Charcot Ave, San Jose, CA, 95131
Manufacturer	Nantong Kefei Technology Co., Ltd.
Manufacturer address	Room 1604，Building 8, Xinghu 101 Square，Nantong Economic and Technological Development Zone

2.2. General information

EUT Description			
Model	Perceptor M2		
SN	FH04021A1900003		
Hardware Version	V1.1		
Software Version	V1.16		
Power Supply	Battery / AC adapter		
Antenna Type	Internal Antenna		
Antenna Gain	Wi-Fi 2.4G	Antenna 1	Antenna 2
		1.00 dBi	-0.50 dBi
	Bluetooth LE Antenna	2.00 dBi	
Directional Gain	For Power	0.31 dBi	
	For PSD	0.31 dBi	
Operating Frequency Range(s)	802.11b/g/n(HT20) 802.11n(HT40) Bluetooth LE V5.0: 2402 ~2480 MHz		
Modulation Type	802.11b: DSSS 802.11g/n(HT20/HT40): OFDM Bluetooth LE: GFSK		
Max. Conducted Power	Wi-Fi 2.4G: 18.57dBm Bluetooth LE: 5.89 dBm		
EUT Accessory			
Adapter	Manufacturer: Shenzhen Tianyin Electronics CO.,LTD. Model: TPA-10R120150UU01HS		
Battery	Manufacturer: Jiade Energy Technology (Zhuhai) Co., Ltd. Model: FH04(JKSG)		
USB Cable	Manufacturer: SUZHOU KELI SCIENCE&TECHNOLOGY DEVELOPMENT CO.,LTD. Model: KLC-5243		
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.			

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3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15C (2020) Radio Frequency Devices

ANSI C63.10 (2013)

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

KDB 662911 D01 Multiple Transmitter Output v02r01

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4. Test Configuration

Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the loop antenna is vertical, the others are vertical and horizontal. and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Test Mode	Data Rate		
	Antenna 1	Antenna 2	MIMO
802.11b	1 Mbps	1 Mbps	/
802.11g	6 Mbps	6 Mbps	/
802.11n HT20	MCS0	MCS0	MCS8
802.11n HT40	MCS0	MCS0	MCS8

The worst case Antenna mode for each of the following tests for Wi-Fi:

Test Cases	Antenna 1	Antenna 2	MIMO
Maximum conducted output power	O	O	O
6dB Bandwidth	--	--	O
Band Edge	--	--	O
Power Spectral Density	O	O	O
Spurious RF Conducted Emissions	--	--	O
Unwanted Emissions	--	--	O
Conducted Emission	--	--	O
Note: “O”: test all bands			

According to RF Output power results in chapter 5.1, MIMO was selected as the worst antenna

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5. Test Case Results

5.1. Maximum output power

Ambient condition

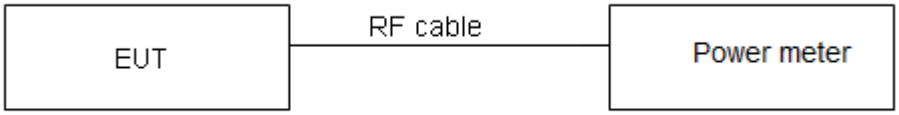
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to Power meter with a known loss. The EUT is max power transmission with proper modulation.

The conducted Power is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test Setup



Limits

Rule Part 15.247 (b) (3) specifies that " For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz: 1 Watt."

Average Output Power	≤ 1W (30dBm)

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.44 dB.

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Test Results

SISO Antenna Power Index						
Antenna	Channel	802.11b	802.11g	802.11n HT20	Channel	802.11n HT40
Antenna 1	CH1	15	12	12	CH3	12
	CH6	15	12	12	CH6	12
	CH11	15	12	12	CH9	12
Antenna 2	CH1	15	12	12	CH3	12
	CH6	15	12	12	CH6	12
	CH11	15	12	12	CH9	12
MIMO Antenna Power Index						
Antenna	Channel	802.11b	802.11g	802.11n HT20	Channel	802.11n HT40
Antenna 1	CH1	15	12	12	CH3	12
	CH6	15	12	12	CH6	12
	CH11	15	12	12	CH9	12
Antenna 2	CH1	15	12	12	CH3	12
	CH6	15	12	12	CH6	12
	CH11	15	12	12	CH9	12

Test Mode	T_{on} (ms)	$T_{(on+off)}$ (ms)	Duty cycle	Duty cycle correction Factor(dB)
802.11b	12.20	12.32	0.99	0.00
802.11g	1.00	1.00	1.00	0.00
802.11n HT20	1.70	1.74	0.98	0.00
802.11n HT40	0.84	0.89	0.94	0.25
Bluetooth LE	0.39	0.62	0.622	2.064
Note: when Duty cycle⩾0.98, Duty cycle correction Factor not required.				

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
Bluetooth (Low Energy)	2402/CH0	3.26	5.33	30	PASS
	2440/CH19	2.33	4.40	30	PASS
	2480/CH39	3.83	5.89	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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SISO Antenna 1

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH 1	15.21	15.21	30	PASS
	2437/CH 6	15.19	15.19	30	PASS
	2462/CH11	15.31	15.31	30	PASS
802.11g	2412/CH 1	12.73	12.73	30	PASS
	2437/CH 6	12.53	12.53	30	PASS
	2462/CH11	12.71	12.71	30	PASS
802.11n HT20	2412/CH 1	12.54	12.54	30	PASS
	2437/CH 6	12.33	12.33	30	PASS
	2462/CH11	12.58	12.58	30	PASS
802.11n HT40	2422/CH3	12.10	12.35	30	PASS
	2437/CH6	11.95	12.20	30	PASS
	2452/CH9	11.88	12.13	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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SISO Antenna 2

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH 1	15.82	15.82	30	PASS
	2437/CH 6	16.02	16.02	30	PASS
	2462/CH11	16.03	16.03	30	PASS
802.11g	2412/CH 1	13.23	13.23	30	PASS
	2437/CH 6	13.14	13.14	30	PASS
	2462/CH11	13.21	13.21	30	PASS
802.11n HT20	2412/CH 1	13.06	13.06	30	PASS
	2437/CH 6	13.02	13.02	30	PASS
	2462/CH11	13.04	13.04	30	PASS
802.11n HT40	2422/CH3	12.87	13.12	30	PASS
	2437/CH6	12.69	12.94	30	PASS
	2452/CH9	12.37	12.62	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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MIMO

Test Mode	Carrier frequency (MHz) / Channel	MIMO Antenna 1		MIMO Antenna 2		Total Power (dBm)	Limit (dBm)	Conclusion
		Average Power Measured (dBm)	Average Power with duty factor (dBm)	Average Power Measured (dBm)	Average Power with duty factor (dBm)			
802.11b HT20	2412/CH 1	15.04	15.04	15.82	15.82	18.46	30	PASS
	2437/CH 6	14.94	14.94	15.97	15.97	18.50	30	PASS
	2462/CH11	14.96	14.96	16.08	16.08	18.57	30	PASS
802.11g HT20	2412/CH 1	12.44	12.44	13.06	13.06	15.77	30	PASS
	2437/CH 6	12.21	12.21	13.04	13.04	15.66	30	PASS
	2462/CH11	12.14	12.14	13.03	13.03	15.62	30	PASS
802.11n HT20	2412/CH 1	12.45	12.45	12.78	12.78	15.63	30	PASS
	2437/CH 6	12.07	12.07	12.91	12.91	15.52	30	PASS
	2462/CH11	12.11	12.11	12.87	12.87	15.52	30	PASS
802.11n HT40	2422/CH3	11.91	12.16	12.65	12.90	15.56	30	PASS
	2437/CH6	11.55	11.80	12.58	12.83	15.36	30	PASS
	2452/CH9	11.44	11.69	12.22	12.47	15.11	30	PASS

Note: 1. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F)2)d)(ii): If antenna gains are not equal, If all transmit signals are completely uncorrelated, then Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10})/N_{ANT}]$ dBi = $10 \log[(10^{G1/10} + 10^{G2/10})/2]$ = 0.31dBi < 6dBi. So the limit is 30 dBm.

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5.2. 99% Bandwidth and 6dB Bandwidth

Ambient condition

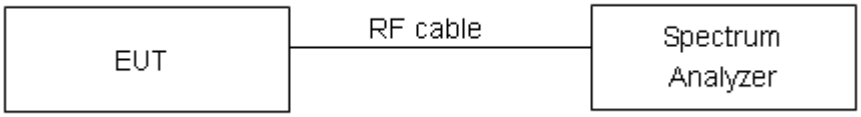
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 100 kHz; VBW is set to 300 kHz on spectrum analyzer. Dector=Peak, Trace mode=max hold.

The EUT was connected to the spectrum analyzer through a known loss cable. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value.

Test Setup



Limits

Rule Part 15.247 (a) (2) specifies that “Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.”

minimum 6 dB bandwidth	≥ 500 kHz

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936 Hz.

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Test Results:

Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
Bluetooth (Low Energy)	2402	1.026	0.653	500	PASS
	2440	1.036	0.665	500	PASS
	2480	1.034	0.660	500	PASS

Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412	13.626	8.066	500	PASS
	2437	13.677	8.050	500	PASS
	2462	13.757	8.072	500	PASS
802.11g	2412	16.526	15.906	500	PASS
	2437	16.552	14.396	500	PASS
	2462	16.548	16.273	500	PASS
802.11n HT20	2412	17.728	15.035	500	PASS
	2437	17.755	16.123	500	PASS
	2462	17.721	15.762	500	PASS
802.11n HT40	2422	36.128	34.522	500	PASS
	2437	36.260	35.469	500	PASS
	2452	36.377	36.020	500	PASS

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99%bandwidth

Bluetooth LE Carrier frequency (MHz): 2402

Bluetooth LE Carrier frequency (MHz): 2440

Bluetooth LE Carrier frequency (MHz): 2480

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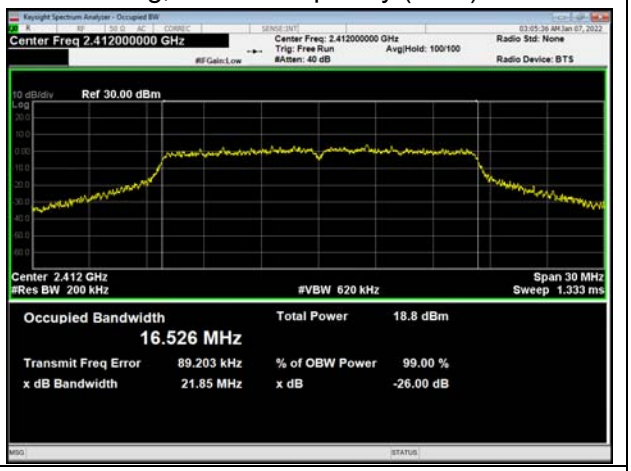
802.11b, Carrier frequency (MHz): 2412

802.11g, Carrier frequency (MHz): 2412



802.11b, Carrier frequency (MHz): 2437

802.11g, Carrier frequency (MHz): 2437

802.11b, Carrier frequency (MHz):2462

802.11g, Carrier frequency (MHz):2462

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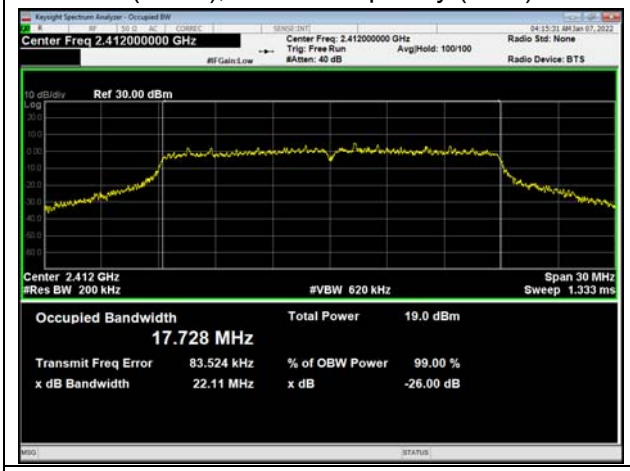
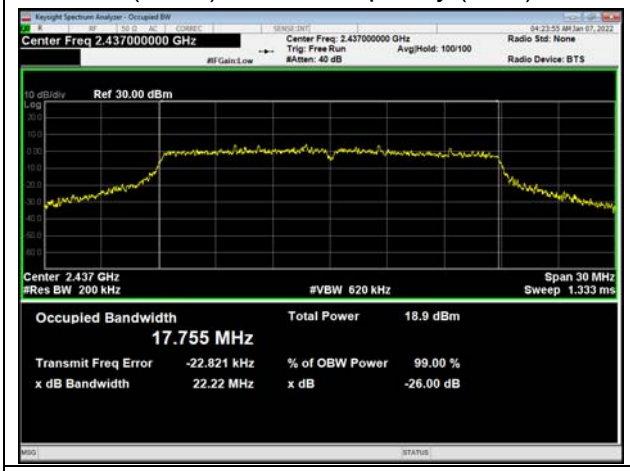
802.11n(HT20), Carrier frequency (MHz): 2412



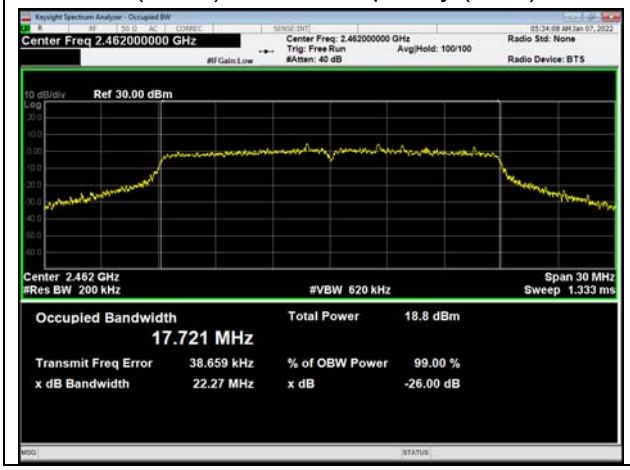
802.11n(HT40), Carrier frequency (MHz): 2422

802.11n(HT20), Carrier frequency (MHz): 2437

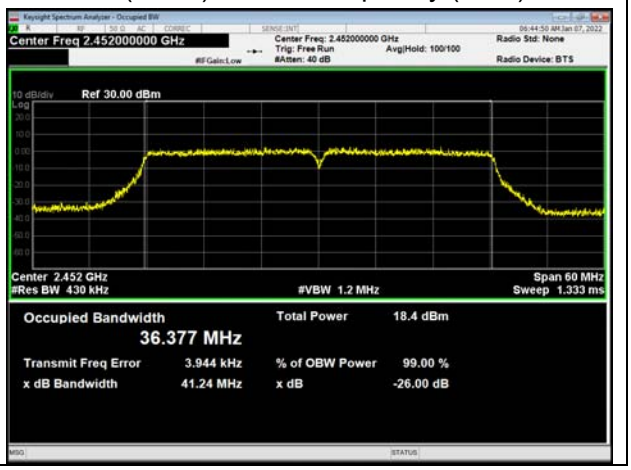


802.11n(HT40), Carrier frequency (MHz): 2437

802.11n(HT20), Carrier frequency (MHz):2462



802.11n(HT40), Carrier frequency (MHz):2452



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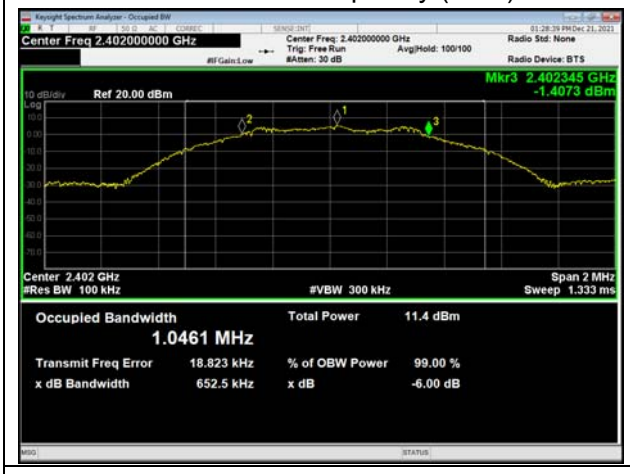
6 dB bandwidth

Bluetooth LE Carrier frequency (MHz): 2402



Bluetooth LE Carrier frequency (MHz): 2440

Bluetooth LE Carrier frequency (MHz): 2480

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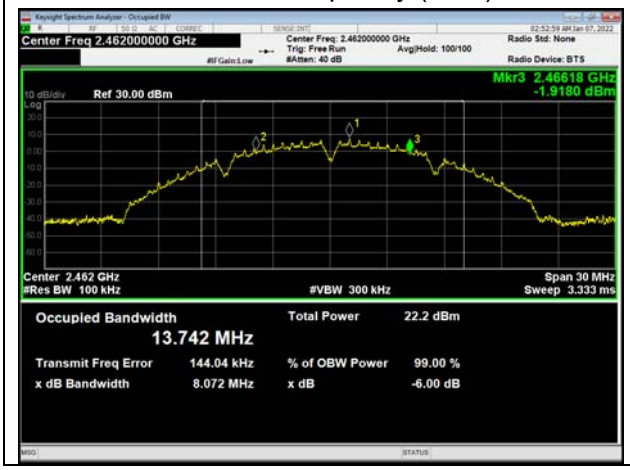
802.11b, Carrier frequency (MHz): 2412

802.11g, Carrier frequency (MHz): 2412

802.11b, Carrier frequency (MHz): 2437

802.11g, Carrier frequency (MHz): 2437

802.11b, Carrier frequency (MHz):2462



802.11g, Carrier frequency (MHz):2462

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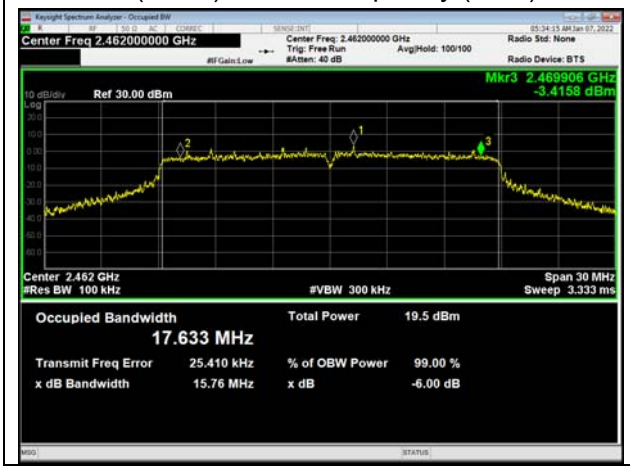
802.11n(HT20), Carrier frequency (MHz): 2412

802.11n(HT40), Carrier frequency (MHz): 2422

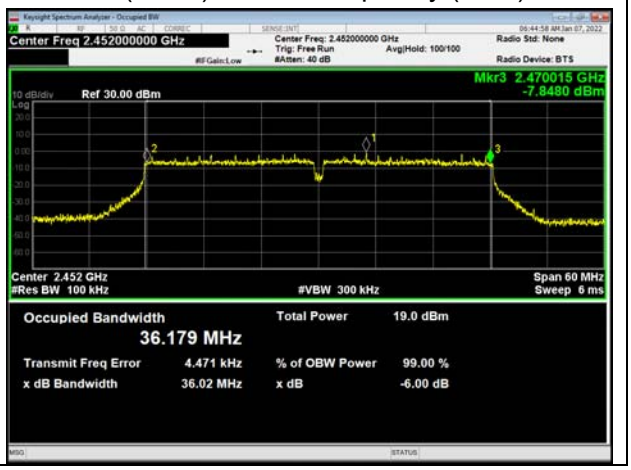
802.11n(HT20), Carrier frequency (MHz): 2437

802.11n(HT40), Carrier frequency (MHz): 2437

802.11n(HT20), Carrier frequency (MHz):2462



802.11n(HT40), Carrier frequency (MHz):2452



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5.3. Band Edge

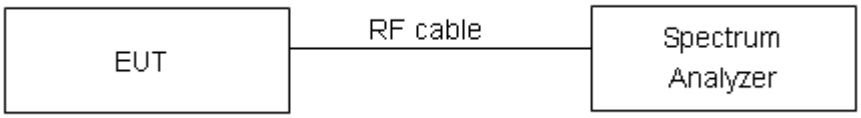
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 15.247(d) specifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.” If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.”

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor *k* = 1.96.

Frequency	Uncertainty
2GHz-3GHz	1.407 dB

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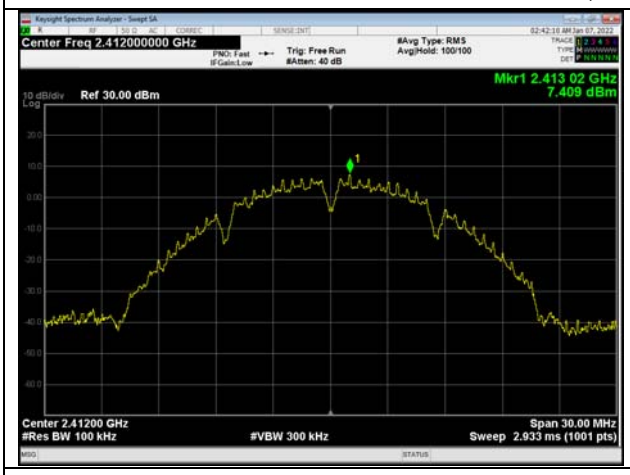
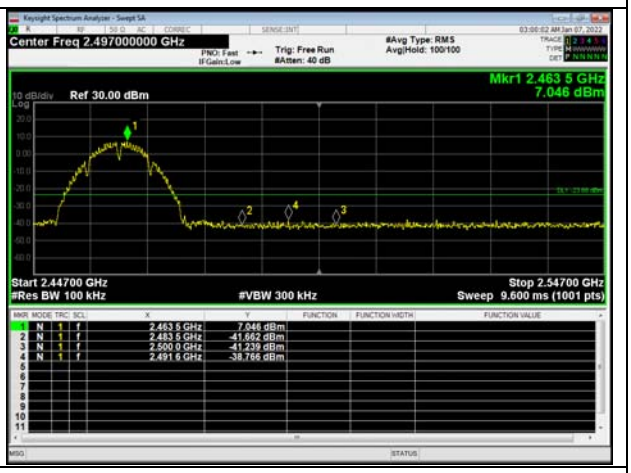
Test Results: PASS

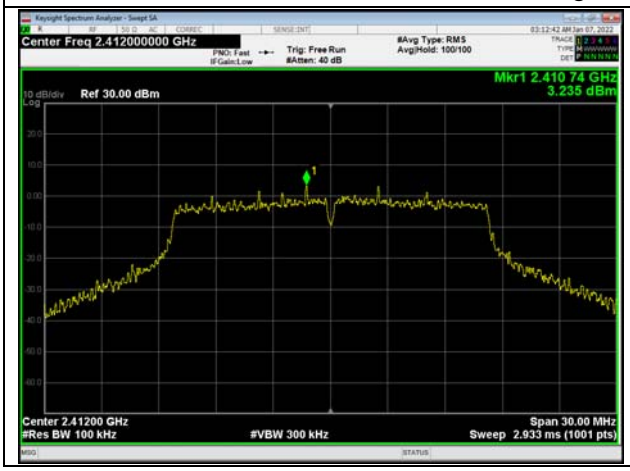
802.11b, Channel No.: 1



802.11b, Channel No.: 11



802.11g, Channel No.: 1



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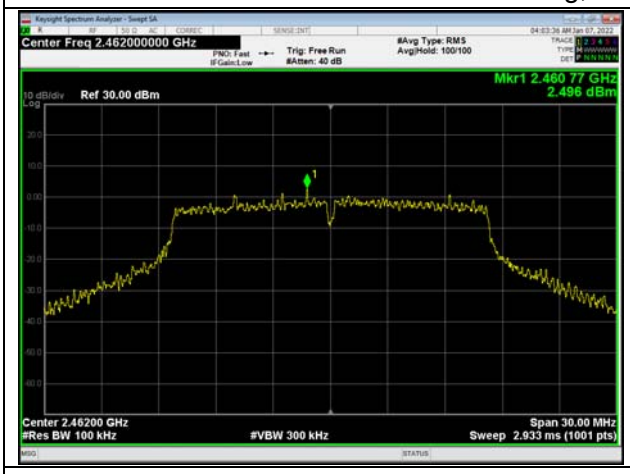
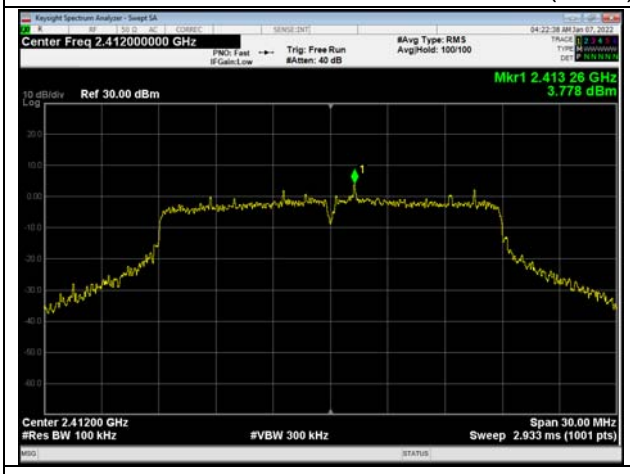
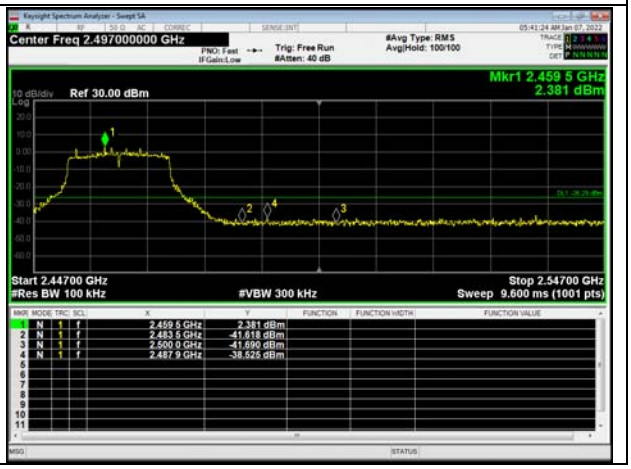
802.11g, Channel No.: 11



802.11n(HT20), Channel No. 1



802.11n(HT20), Channel No. 11



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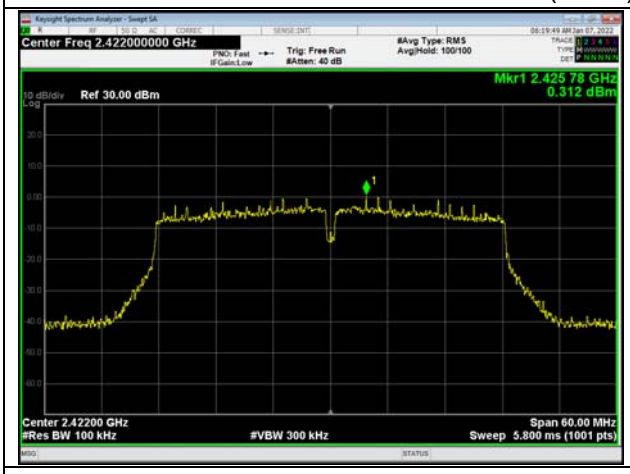
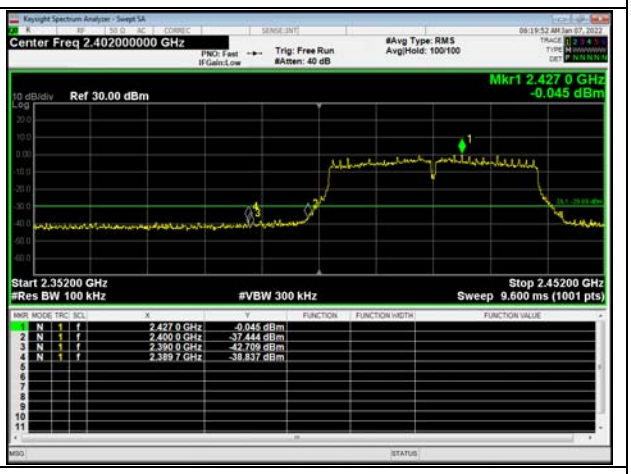
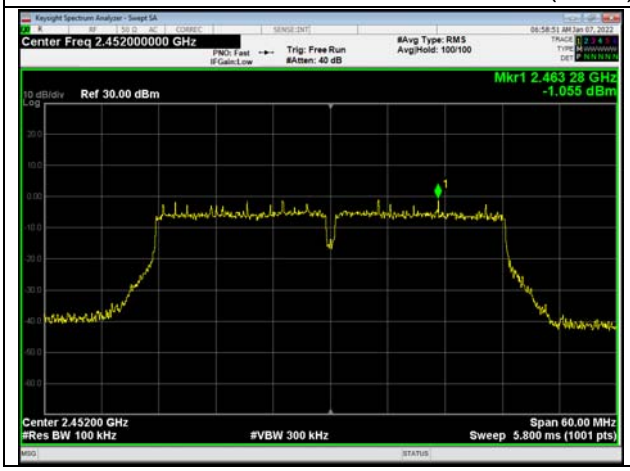
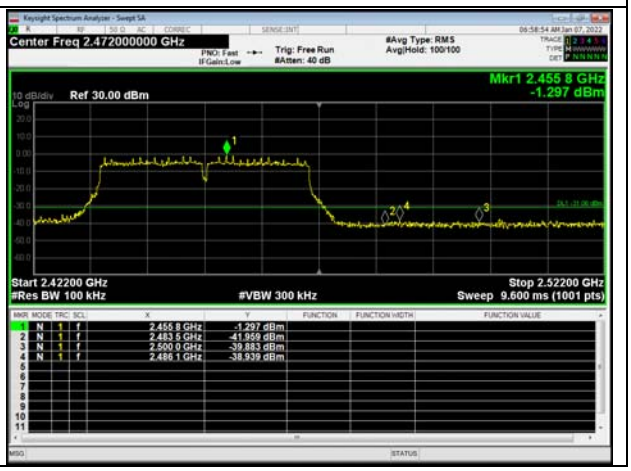
802.11n(HT40), Channel No. 3





802.11n(HT40), Channel No. 9





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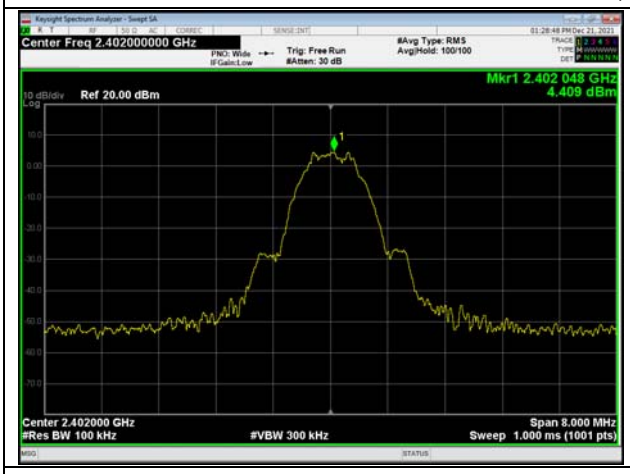
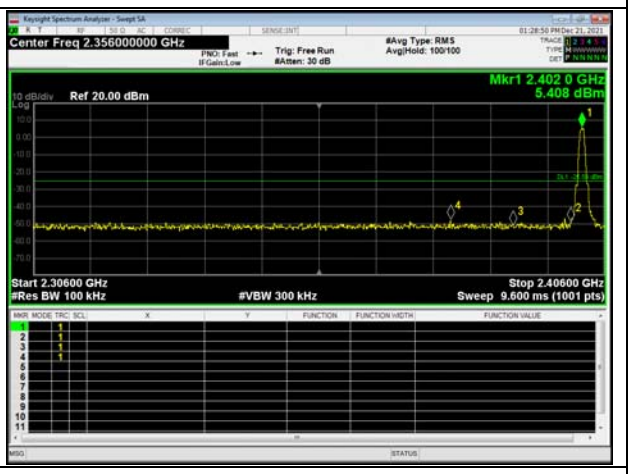
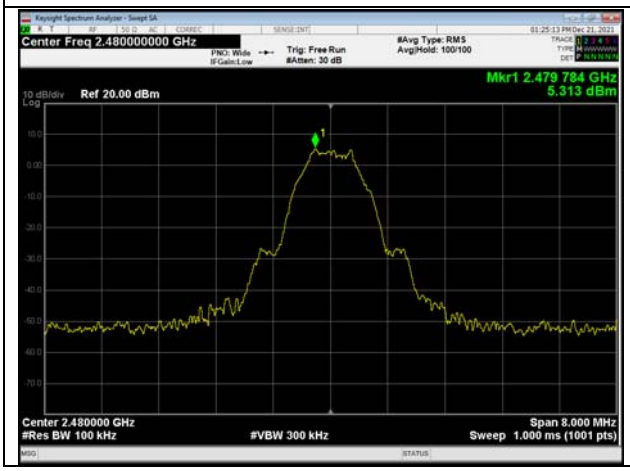
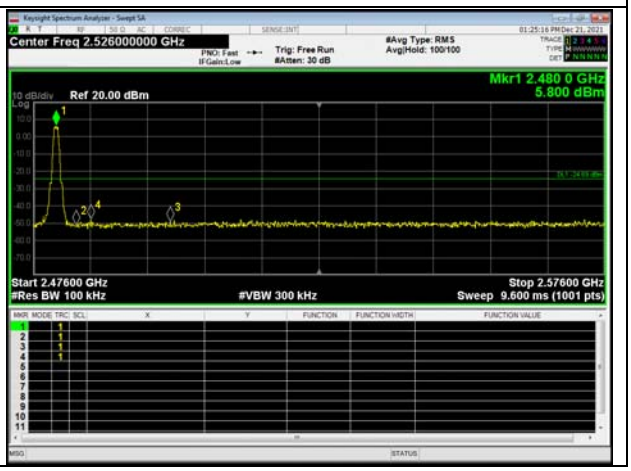
Bluetooth LE, Channel No.: 0





Bluetooth LE, Channel No.: 39





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5.4. Power Spectral Density

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

During the process of the testing, The EUT was connected to Spectrum Analyzer with a known loss. The EUT is max power transmission with proper modulation.

Method AVGPSD-1 was used for this test.

a) Set instrument center frequency to DTS channel center frequency

b) Set span to at least 1.5 times the OBW

c) Set RBW to:3kHz≤RBW≤100kHz

d) Set VBW≥[3x RBW]

e) Detector=power averaging(rms) or sample detector(when rms not available)

f) Ensure that the number of measurement points in the sweep 2[2 X span/RBWT]

g)Sweep time auto couple

h) Employ trace averaging(rms) mode over a minimum of 100 traces

i) Use the peak marker function to determine the maximum amplitude level.

j) If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat(note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)

Method AVGPSD-2 was used for this test.

a) Measure the duty cycle(D)of the transmitter output signal as described in 11.6

b) Set instrument center frequency to DTS channel center frequency

c)Set span to at least 1.5 times the OBW

d) Set RBW to:3kHz≤RBW≤100Kh

e) Set VBW≥[3x RBW]

f)Detector= power averaging(rms) or sample detector (when rms not available)

g) Ensure that the number of measurement points in the sweep 2[2 X span/RBW]

h) Sweep time =auto couple

i) Do not use sweep triggering; allow sweep to "free run”

j) Employ trace averaging(rms) mode over a minimum of 100 traces

k) Use the peak marker function to determine the maximum amplitude level

l) Add [10 log(1/ D)], where D is the duty cycle measured in step a), to the measured PSD to

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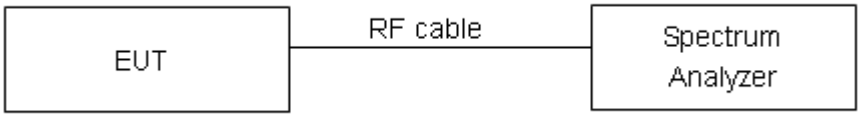
compute the average PSD during the actual transmission time

m) If measured value exceeds requirement specified by regulatory agency then reduce RBW(but o less than 3 kHz) and repeat(note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)

The conducted Power is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test setup



Limits

Rule Part 15.247(e) specifies that" For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. ''

Limits	≤ 8 dBm / 3kHz

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.75dB.

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Test Results:

Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth (Low Energy)	0	-3.23	-1.16	8	PASS
	19	-3.50	-1.43	8	PASS
	39	-2.71	-0.65	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

SISO Antenna 1

Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	1	-16.48	-16.48	8	PASS
	6	-17.35	-17.35	8	PASS
	11	-16.96	-16.96	8	PASS
802.11g	1	-20.62	-20.62	8	PASS
	6	-21.94	-21.94	8	PASS
	11	-21.59	-21.59	8	PASS
802.11n HT20	1	-21.23	-21.23	8	PASS
	6	-22.36	-22.36	8	PASS
	11	-22.26	-22.26	8	PASS
802.11n HT40	3	-25.05	-24.80	8	PASS
	6	-25.03	-24.78	8	PASS
	9	-23.67	-23.42	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

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SISO Antenna 2

Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	1	-16.50	-16.50	8	PASS
	6	-16.29	-16.29	8	PASS
	11	-16.49	-16.49	8	PASS
802.11g	1	-21.17	-21.17	8	PASS
	6	-21.34	-21.34	8	PASS
	11	-21.48	-21.48	8	PASS
802.11n HT20	1	-21.63	-21.63	8	PASS
	6	-21.76	-21.76	8	PASS
	11	-21.77	-21.77	8	PASS
802.11n HT40	3	-24.55	-24.30	8	PASS
	6	-25.12	-24.87	8	PASS
	9	-25.77	-25.52	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

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MIMO Antenna

Test Mode	Channel Number	Power Spectral Density				Total PSD	Limit (dBm / 3kHz)	Conclusion
		Antenna 1		Antenna 2				
		Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	(dBm / 3kHz)		
802.11b	1	-16.65	-16.65	-16.11	-16.11	-13.36	8.00	PASS
	6	-16.89	-16.89	-15.98	-15.98	-13.40	8.00	PASS
	11	-17.16	-17.16	-16.23	-16.23	-13.66	8.00	PASS
802.11g	1	-20.71	-20.71	-20.97	-20.97	-17.83	8.00	PASS
	6	-21.86	-21.86	-20.97	-20.97	-18.38	8.00	PASS
	11	-22.76	-22.76	-21.10	-21.10	-18.84	8.00	PASS
802.11n HT20	1	-22.12	-22.12	-21.78	-21.78	-18.94	8.00	PASS
	6	23.18	23.18	-21.92	-21.92	23.18	8.00	PASS
	11	-23.46	-23.46	-22.29	-22.29	-19.83	8.00	PASS
802.11n HT40	3	-26.08	-25.83	-24.50	-24.25	-21.96	8.00	PASS
	6	-25.46	-25.21	-25.08	-24.83	-22.00	8.00	PASS
	9	-24.78	-24.53	-25.98	-25.73	-22.08	8.00	PASS

Note: 1. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F)2)d)(ii): If antenna gains are not equal, If all transmit signals are completely uncorrelated, then Directional gain = 10 log[($10^{G1/10}$ + $10^{G2/10}$)/N_{ANT}] dBi = 10 log[($10^{G1/10}$ + $10^{G2/10}$)/2] = 0.31dBi < 6dBi. So the limit is 8dBm.

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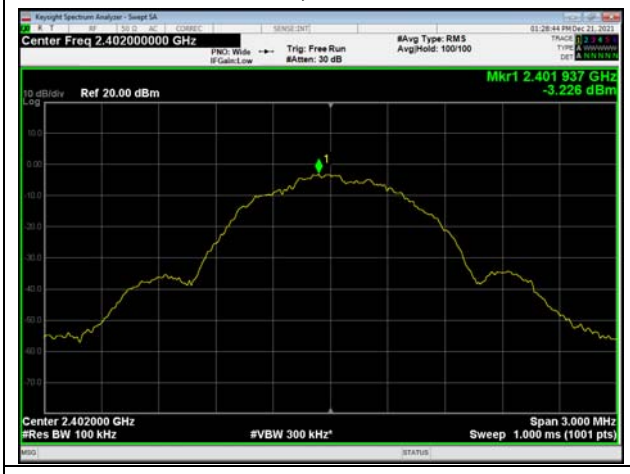
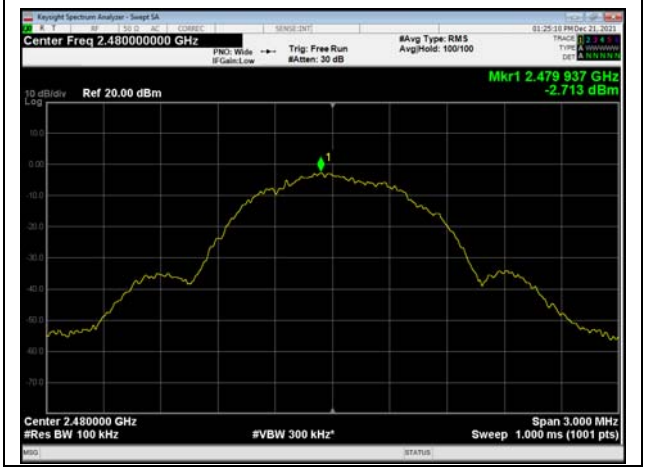
Bluetooth LE, Channel No.: 0



Bluetooth LE, Channel No.: 19

Bluetooth LE, Channel No.: 39



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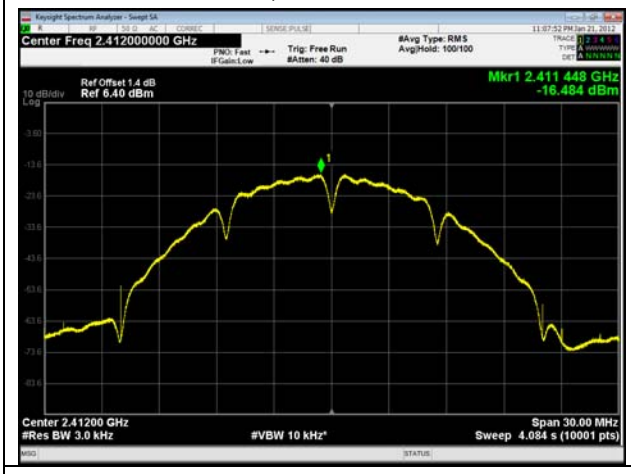
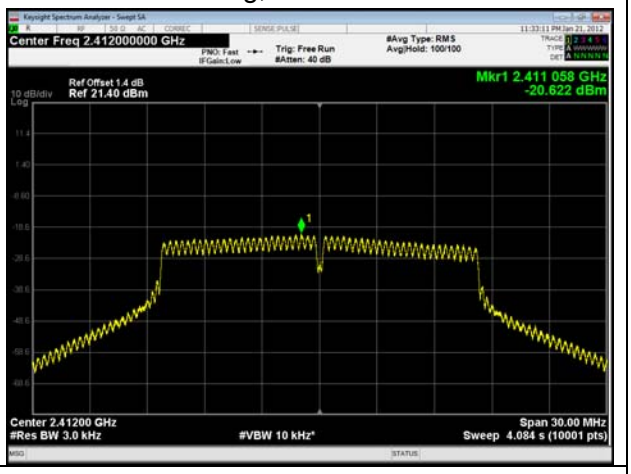
SISO Antenna 1

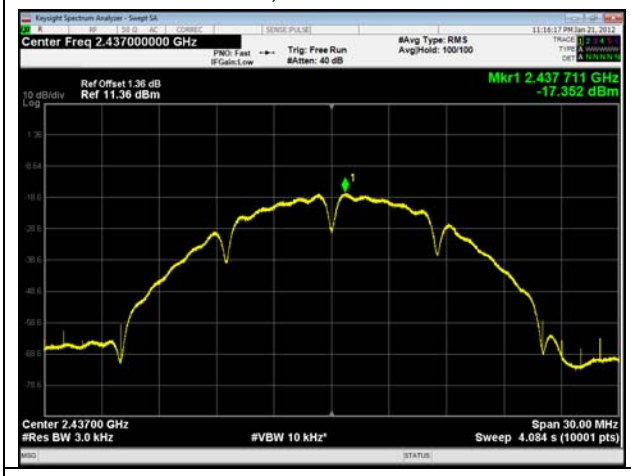
802.11b, Channel No.: 1



802.11g, Channel No.: 1

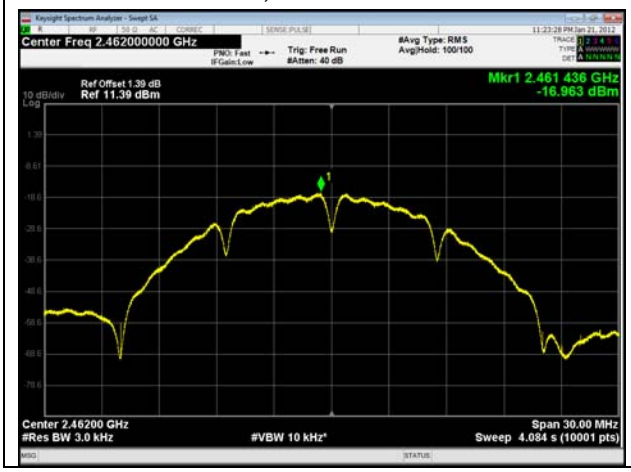


802.11b, Channel No.: 6

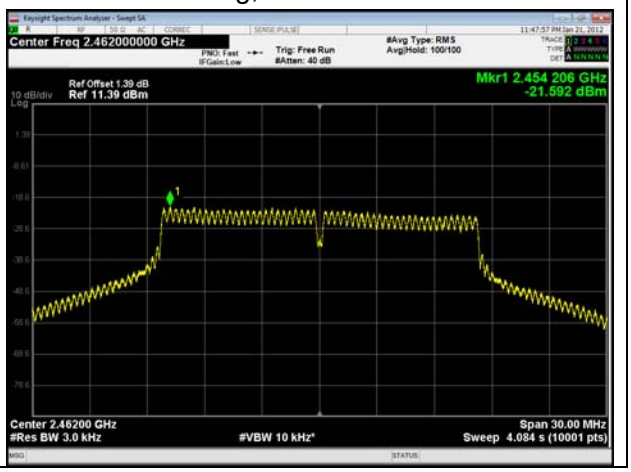


802.11g, Channel No.: 6

802.11b, Channel No.: 11



802.11g, Channel No.: 11



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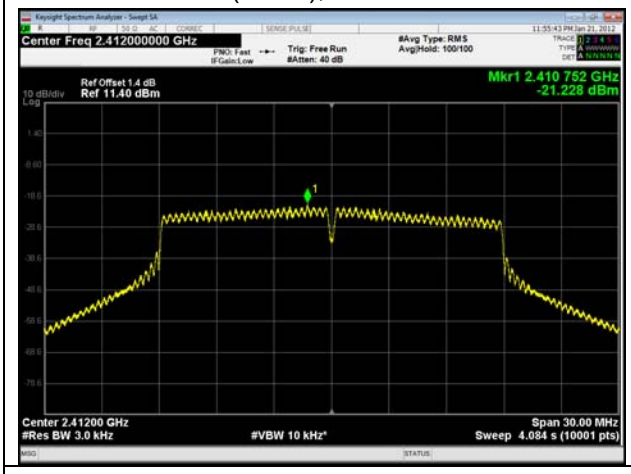
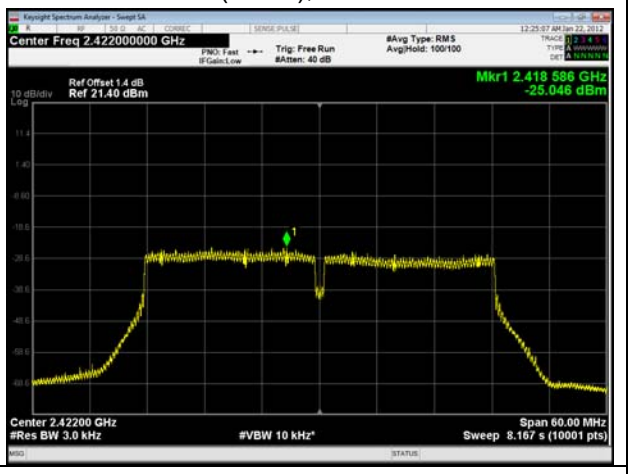
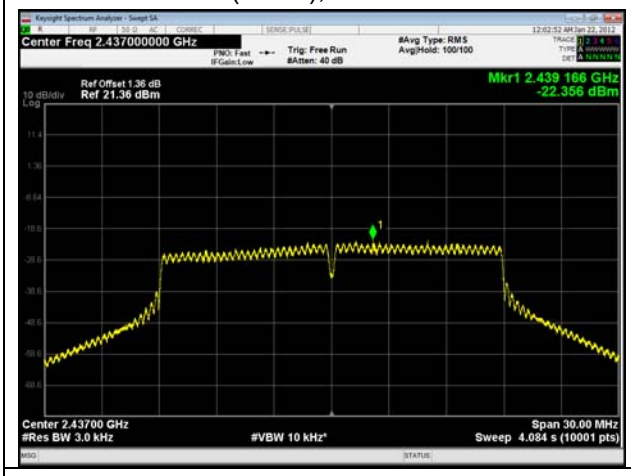
802.11n(HT20), Channel No. 1



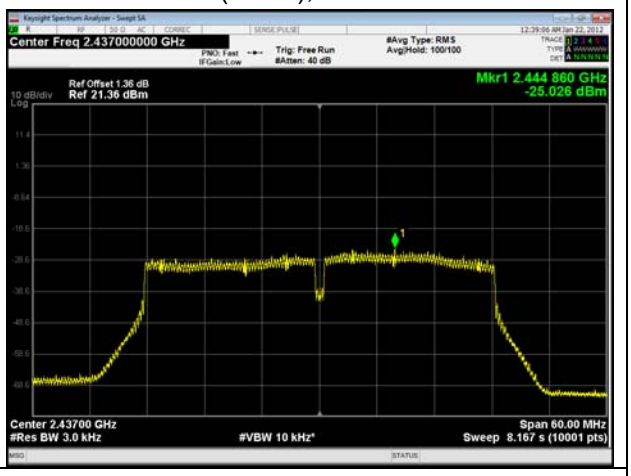
802.11n(HT40), Channel No. 3



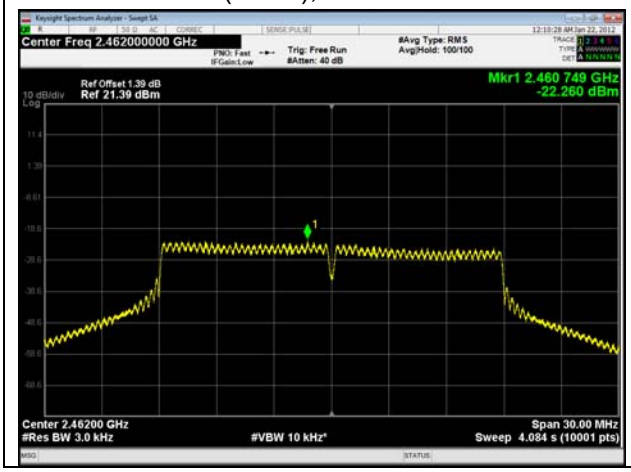
802.11n(HT20), Channel No. 6



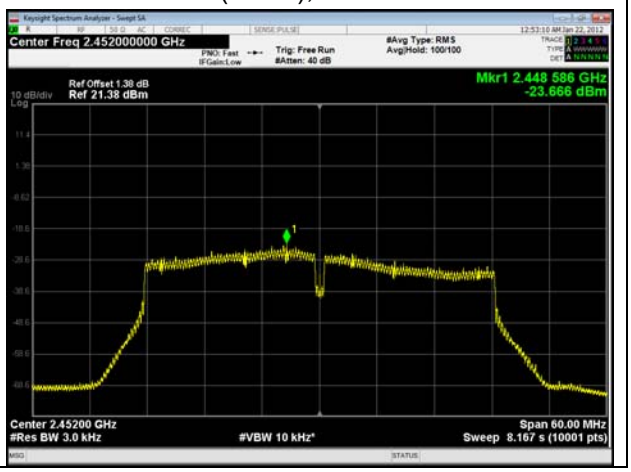
802.11n(HT40), Channel No. 6



802.11n(HT20), Channel No. 11



802.11n(HT40), Channel No. 9



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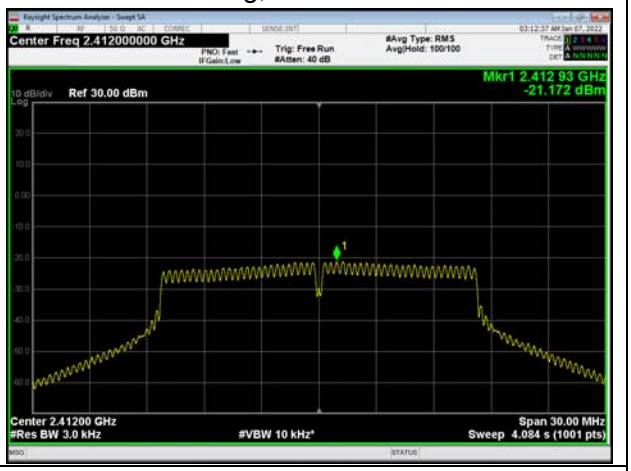
SISO Antenna 2

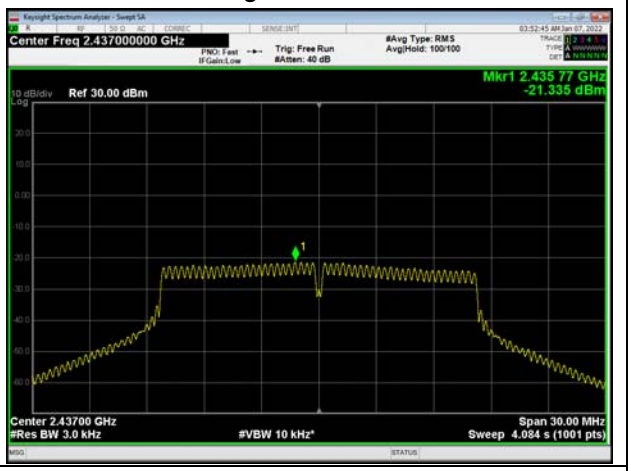
802.11b, Channel No.: 1

802.11g, Channel No.: 1



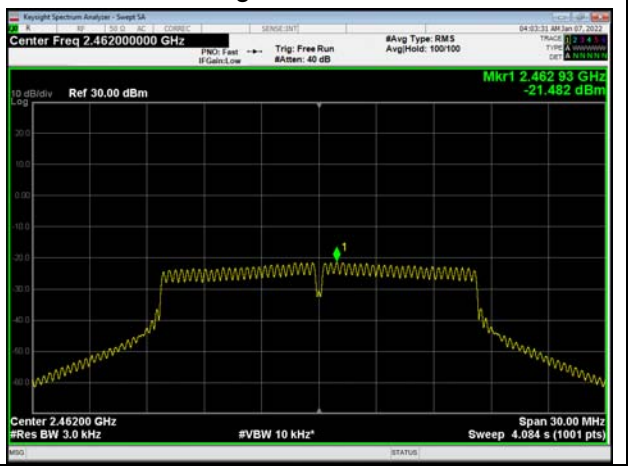
802.11b, Channel No.: 6

802.11g, Channel No.: 6



802.11b, Channel No.: 11

802.11g, Channel No.: 11



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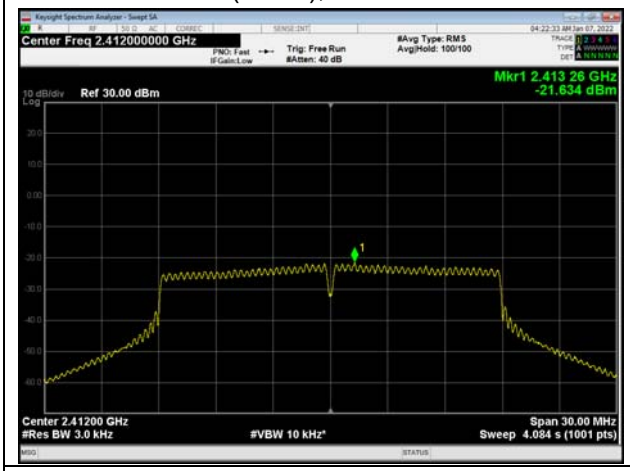
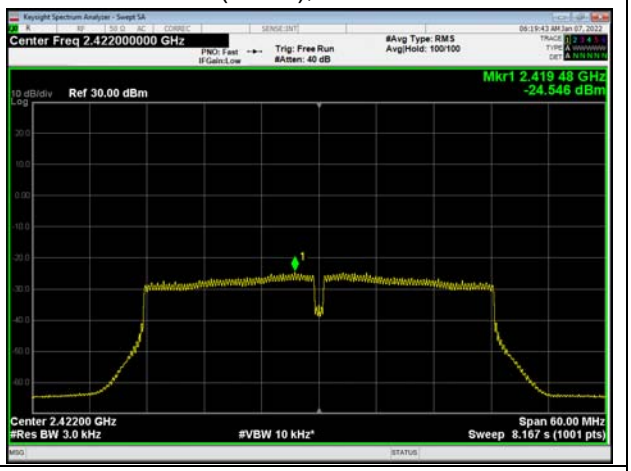
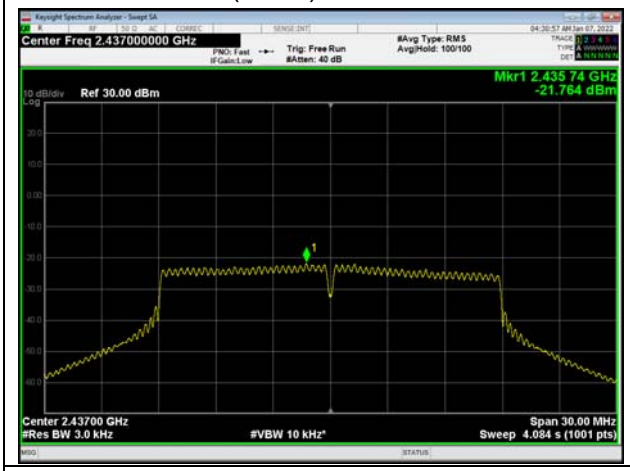
802.11n(HT20), Channel No. 1



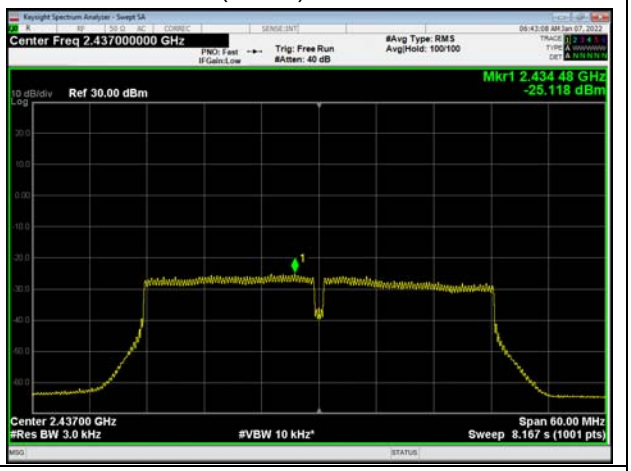
802.11n(HT40), Channel No. 3



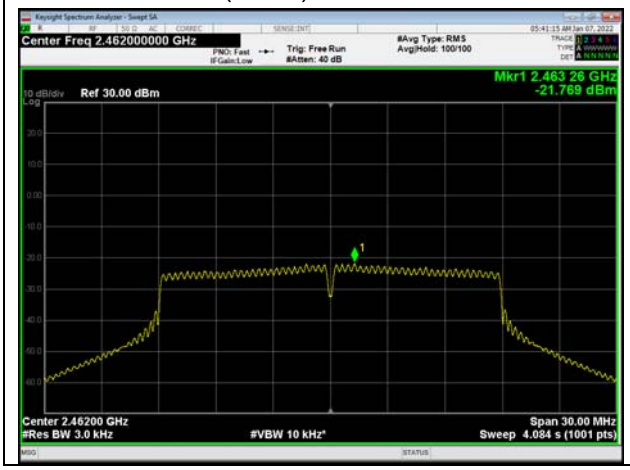
802.11n(HT20), Channel No. 6



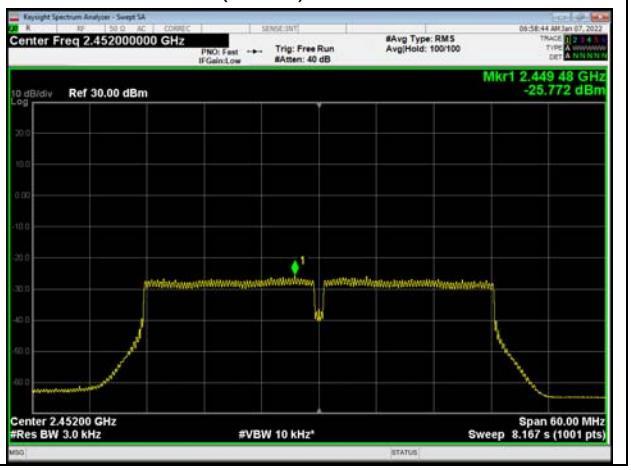
802.11n(HT40), Channel No. 6



802.11n(HT20), Channel No. 11



802.11n(HT40), Channel No. 9



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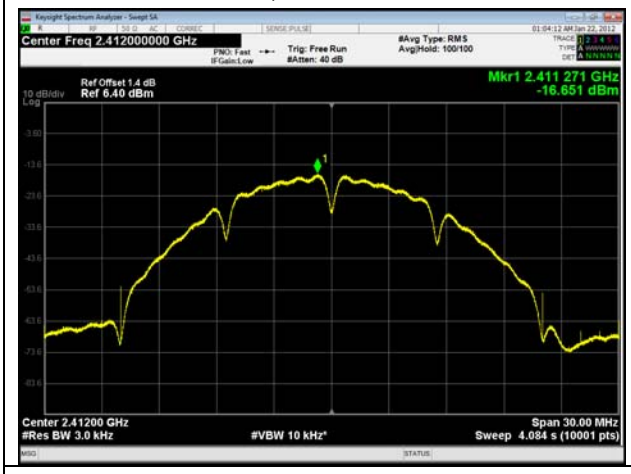
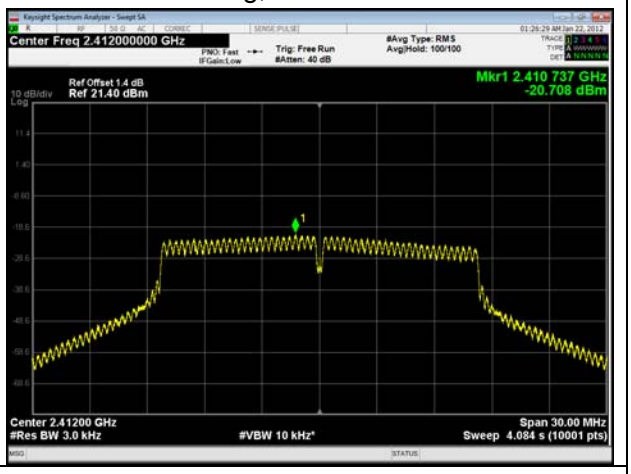
MIMO Antenna 1

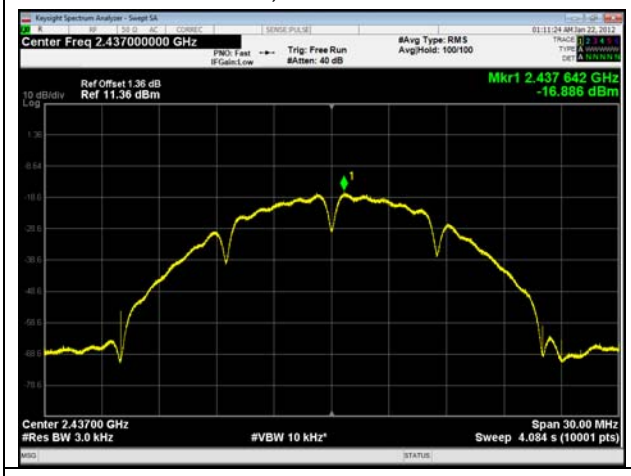
802.11b, Channel No.: 1



802.11g, Channel No.: 1

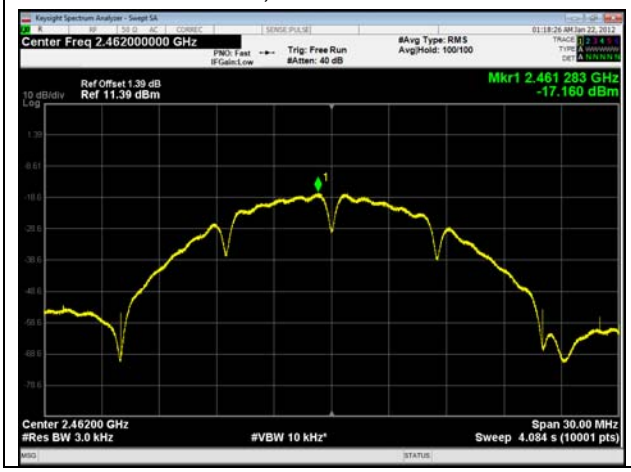


802.11b, Channel No.: 6



802.11g, Channel No.: 6

802.11b, Channel No.: 11



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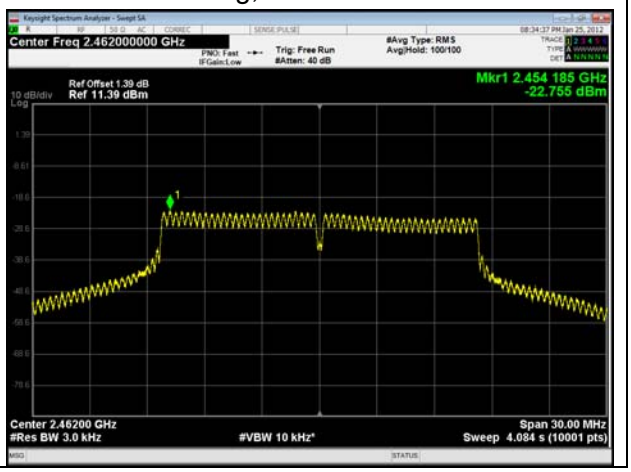

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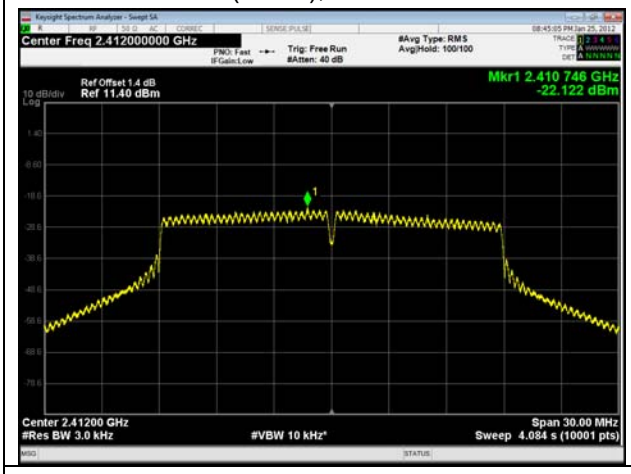
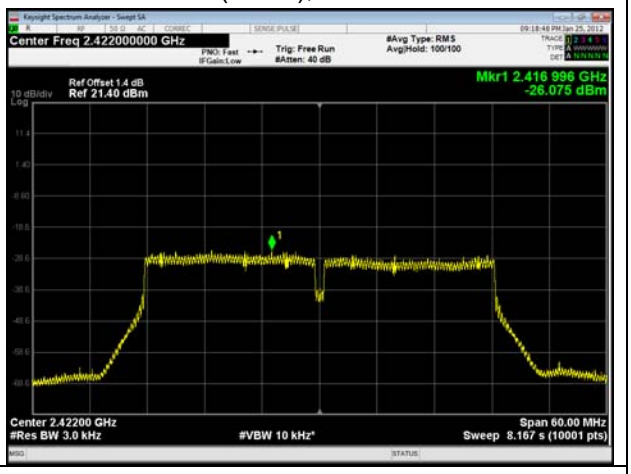
802.11n(HT20), Channel No. 1



802.11n(HT40), Channel No. 3



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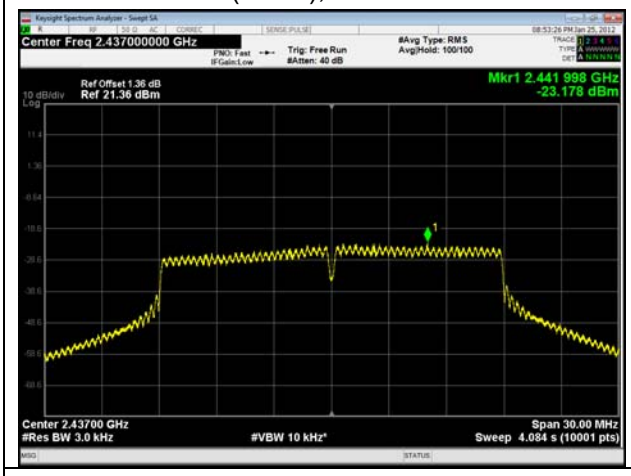

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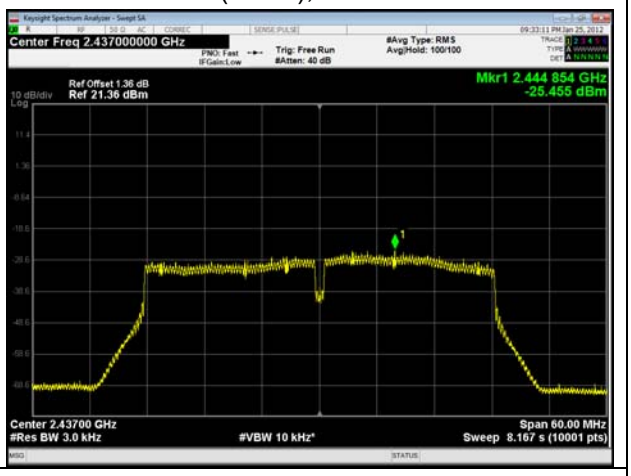

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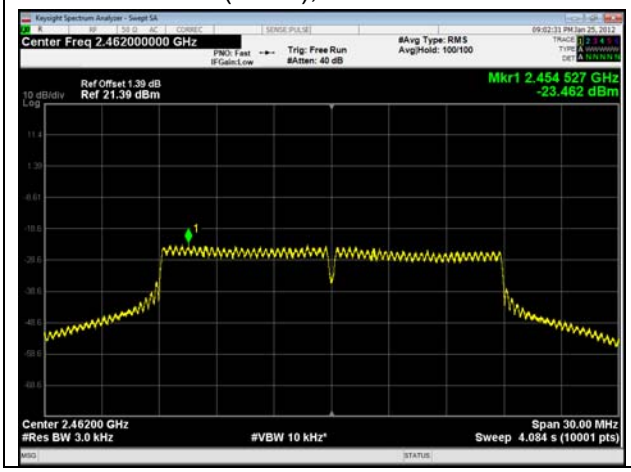
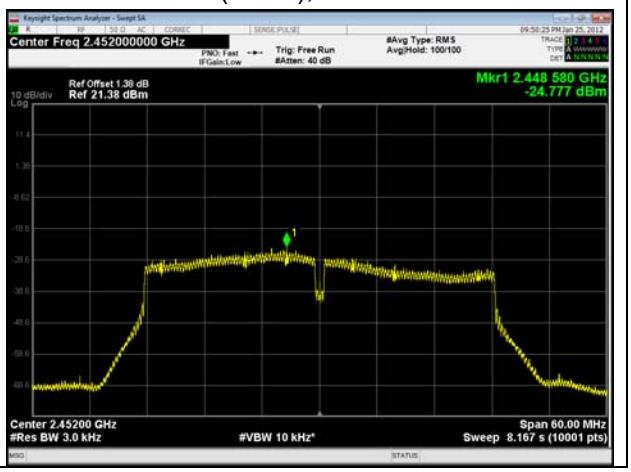


802.11n(HT40), Channel No. 9



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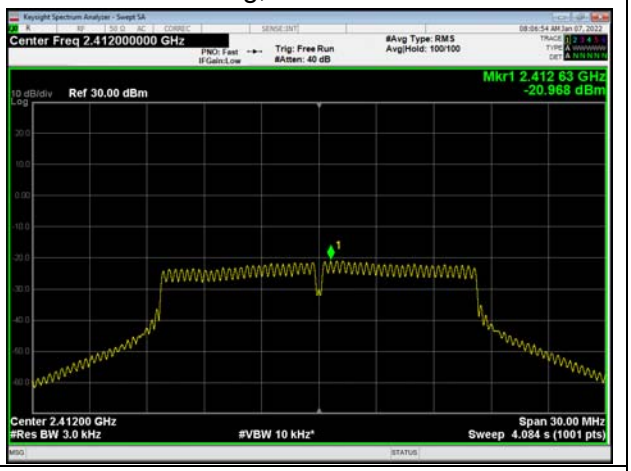
MIMO Antenna 2

802.11b, Channel No.: 1

802.11g, Channel No.: 1



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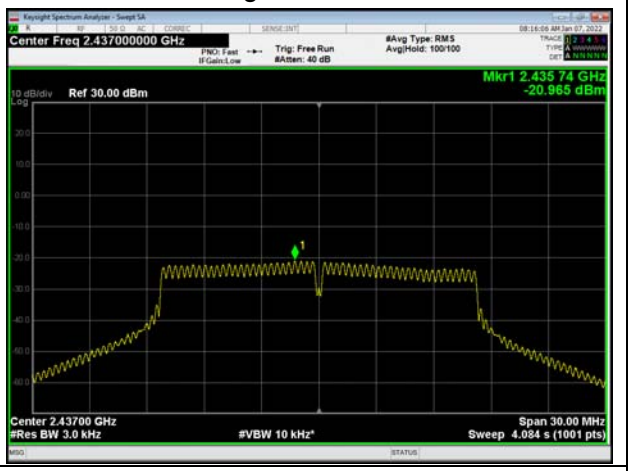
802.11g, Channel No.: 6



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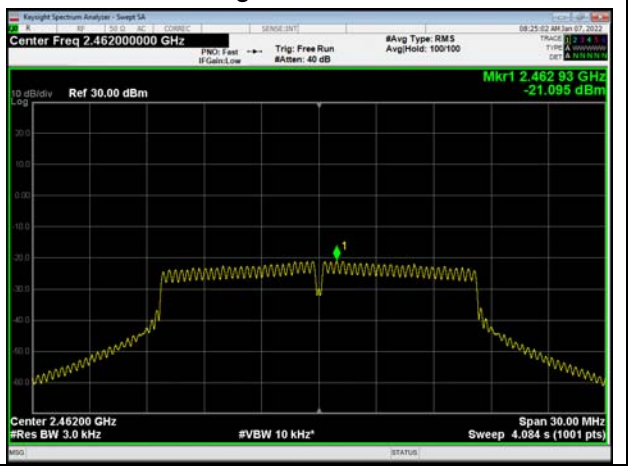
802.11g, Channel No.: 11



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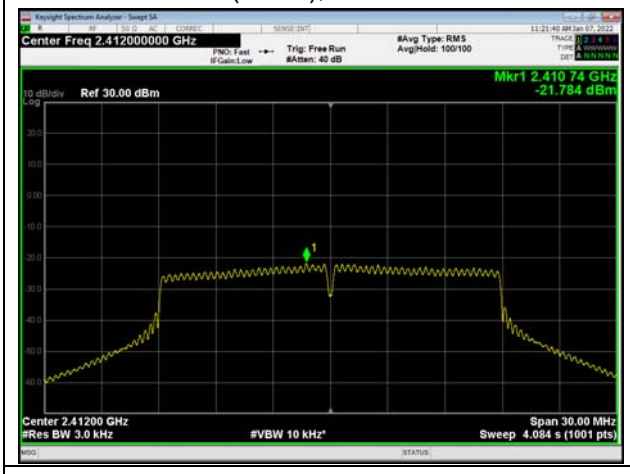
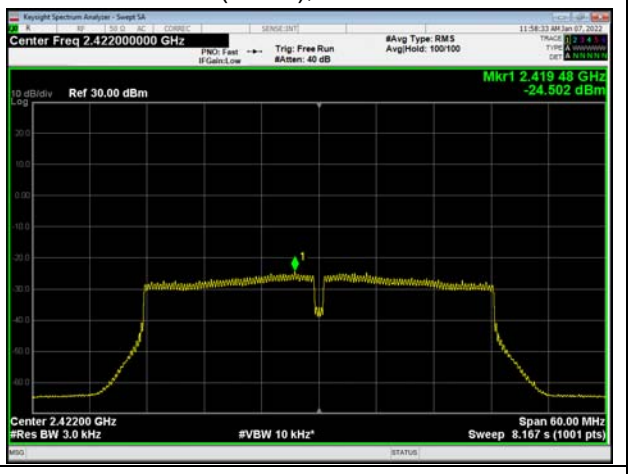
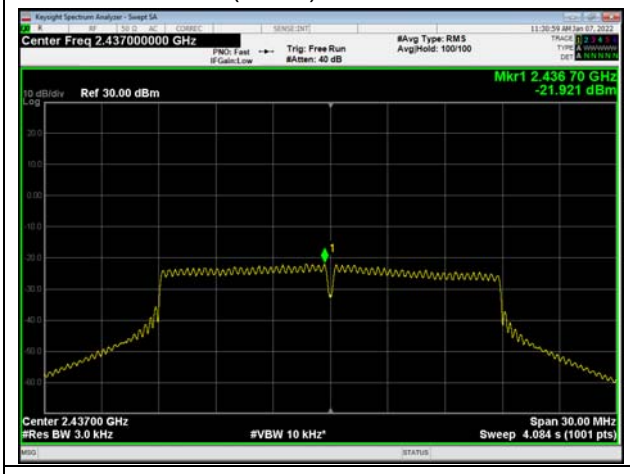
802.11n(HT20), Channel No. 1



802.11n(HT40), Channel No. 3



802.11n(HT20), Channel No. 6



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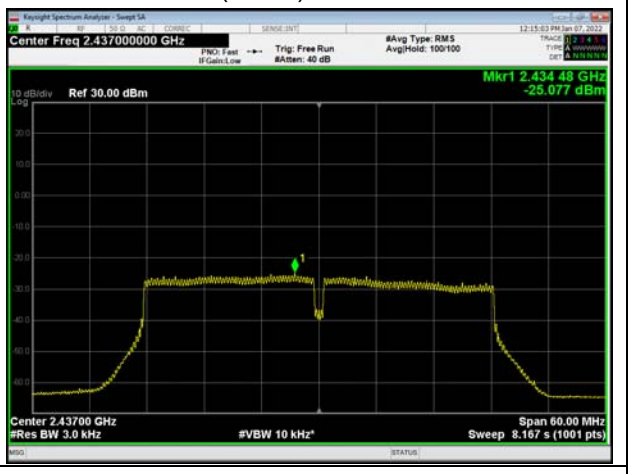

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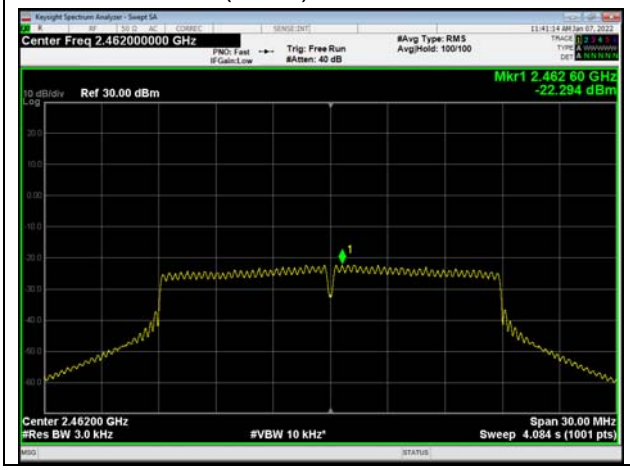
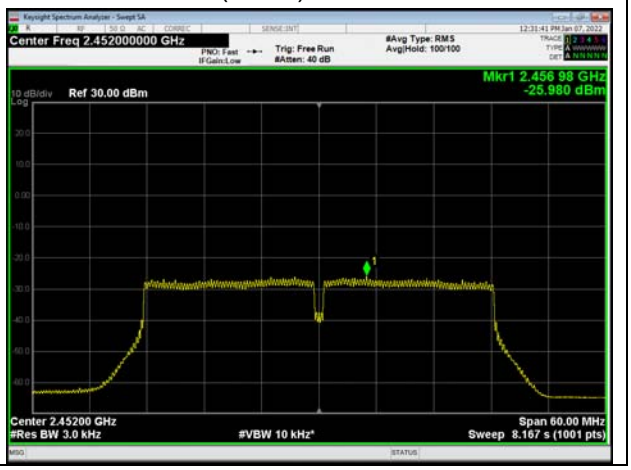


802.11n(HT40), Channel No. 9



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5.5. Spurious RF Conducted Emissions

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. Set RBW to 100 kHz and VBW to 300 kHz, Sweep is set to ATUO.
The test is in transmitting mode.

Test setup

Limits

Rule Part 15.247(d) pacifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. ”

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Test Mode	Carrier frequency (MHz)	Reference value (dBm)	Limit
802.11b	2412	6.96	-23.04
	2437	7.55	-22.45
	2462	7.45	-22.55
802.11g	2412	2.29	-27.71
	2437	2.50	-27.50
	2462	2.72	-27.28
802.11n HT20	2412	2.49	-27.51
	2437	2.76	-27.24
	2462	3.43	-26.57
802.11n HT40	2422	-0.11	-30.11
	2437	0.14	-29.86
	2452	-0.97	-30.97
Bluetooth (Low Energy)	2402	5.26	-24.74
	2440	3.97	-26.03
	2480	5.89	-24.11

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

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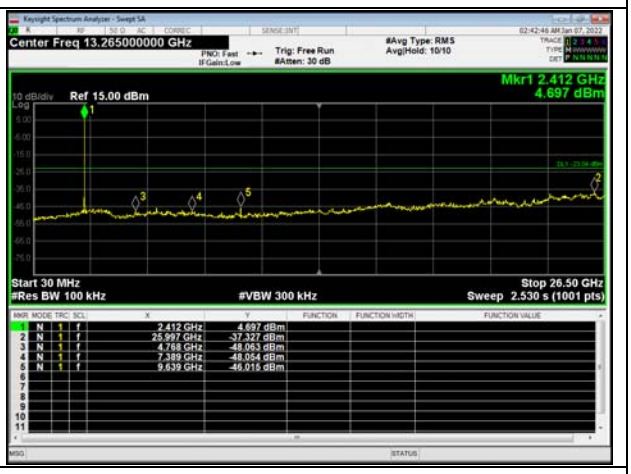
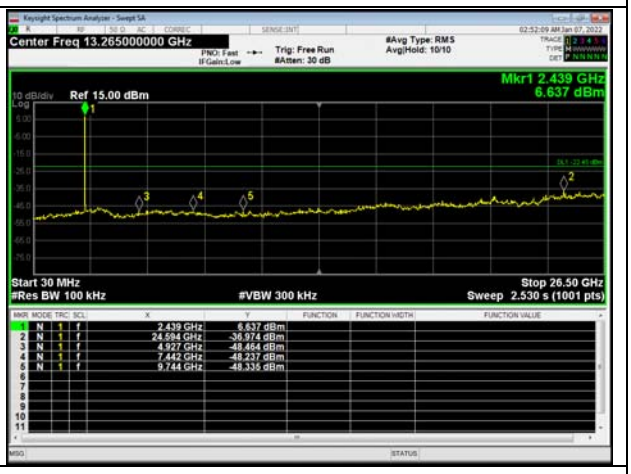
Test Results:

802.11b, Channel No.: 1



802.11b, Channel No.: 6



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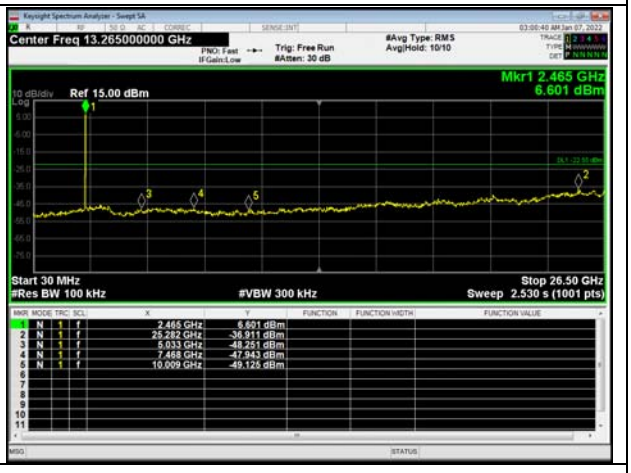

802.11g, Channel No.: 1

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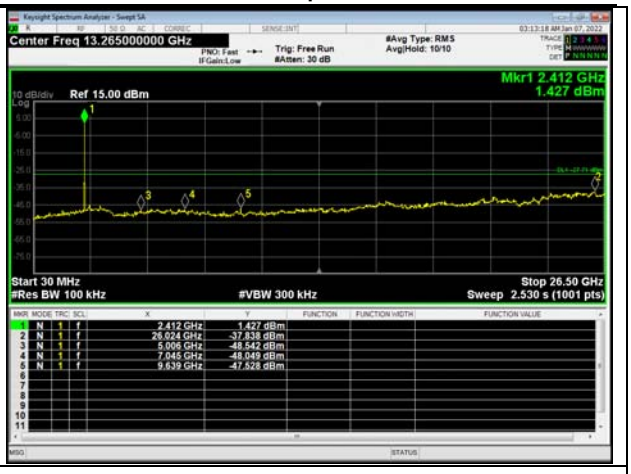

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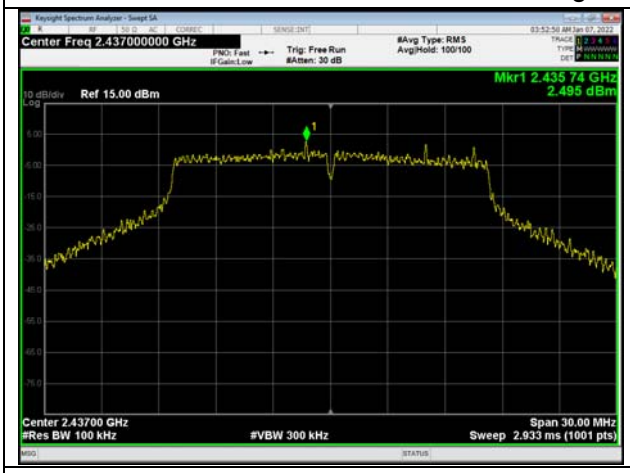
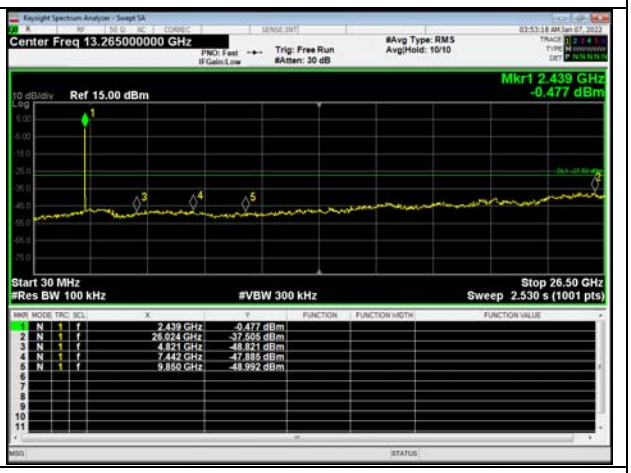
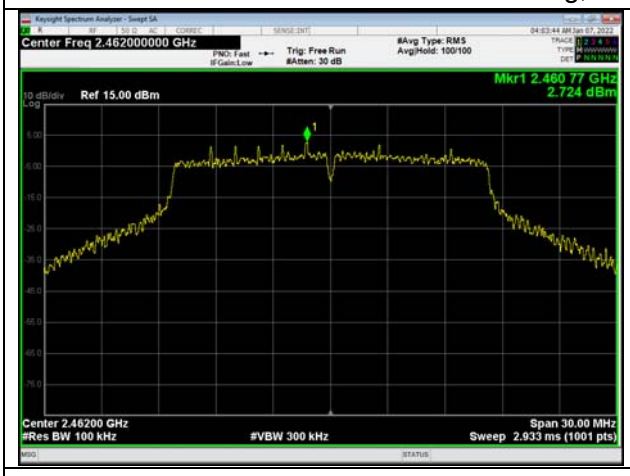
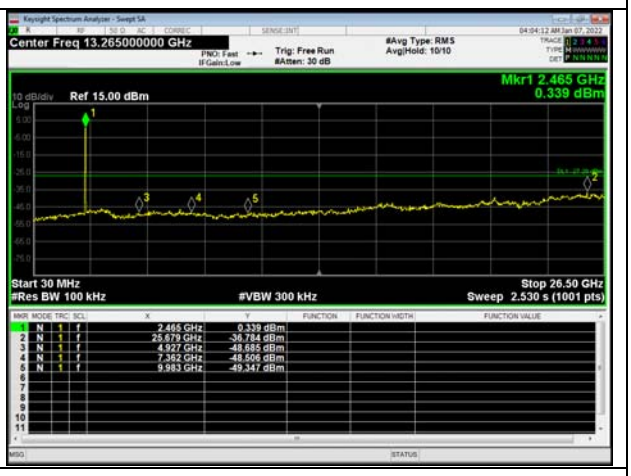




802.11g, Channel No.: 11





802.11n(HT20), Channel No. 1

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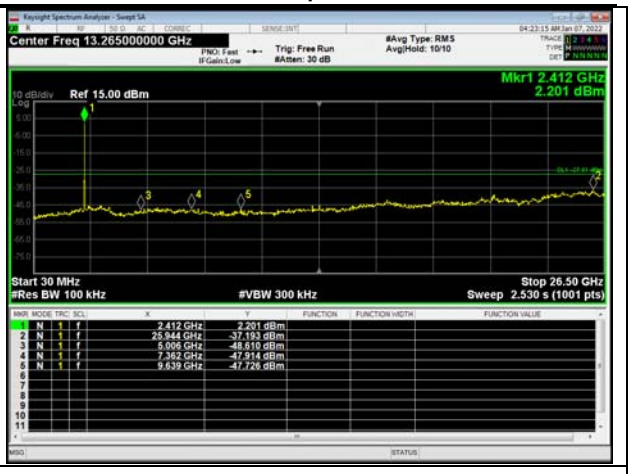
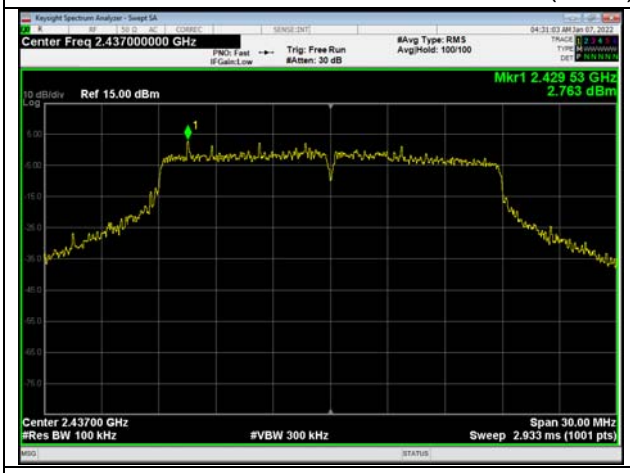
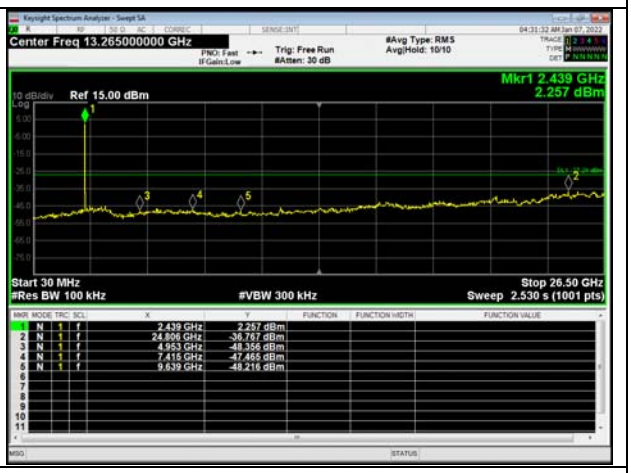


802.11n(HT20), Channel No. 6





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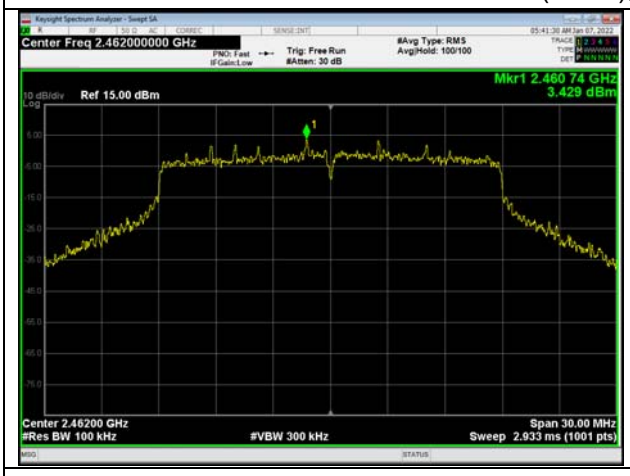

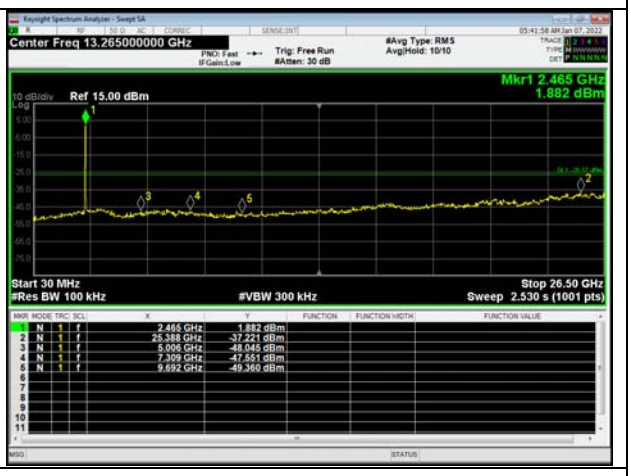

802.11n(HT40), Channel No. 3

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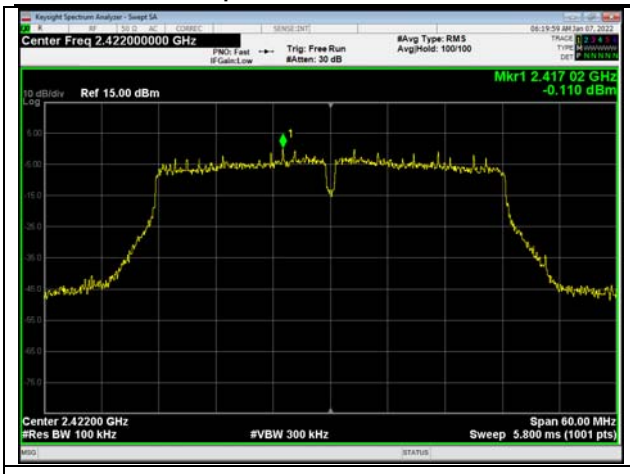
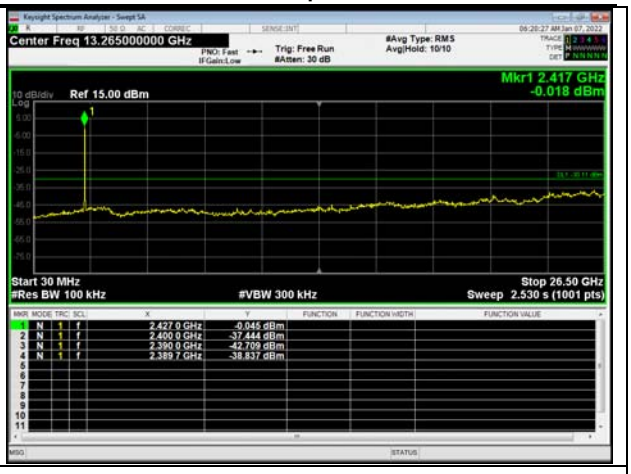
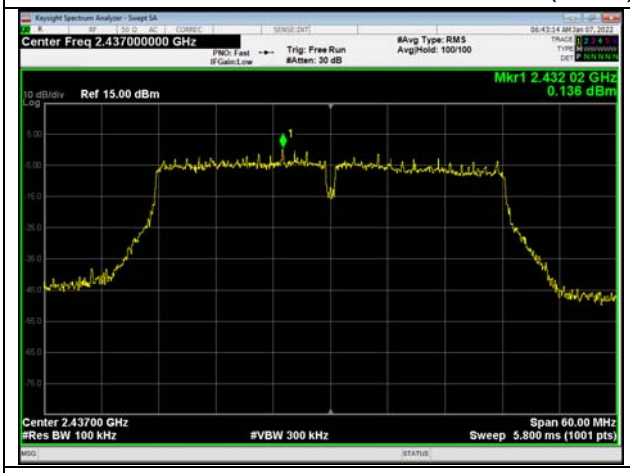
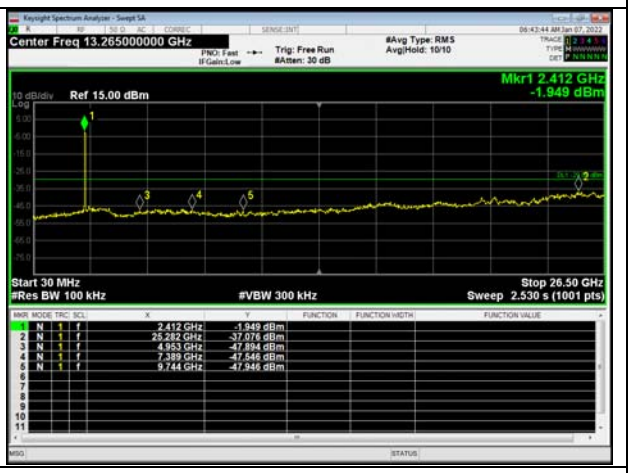




802.11n(HT40), Channel No. 6





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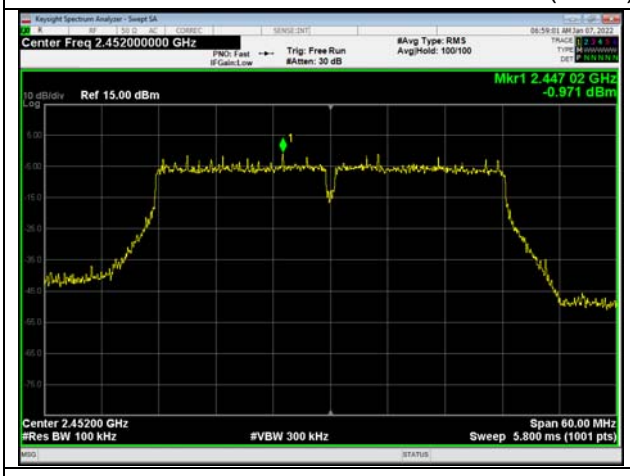

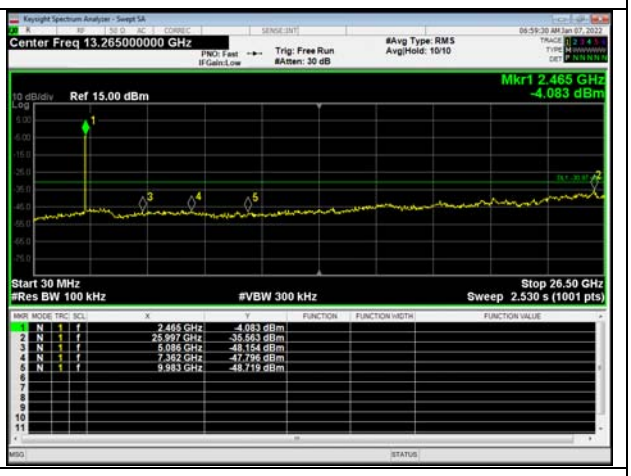

Bluetooth LE, Channel No.: 0

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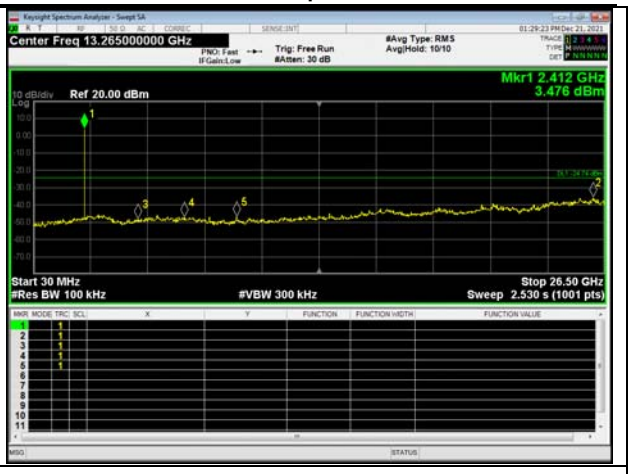
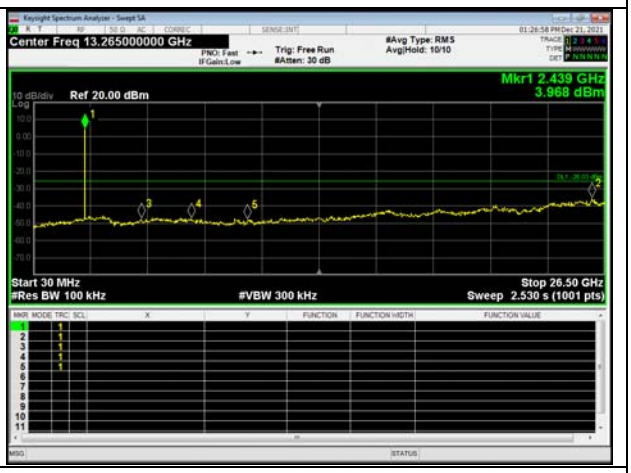


Bluetooth LE, Channel No.: 19



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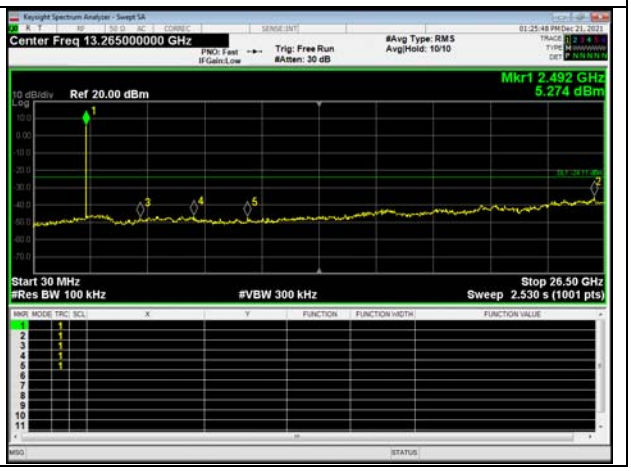

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5.6. Unwanted Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	102.5kPa

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10.
The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.

The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna.The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing. Sweep the Restricted Band and the emissions less than 20 dB below the permissible value are reported.
The radiated emissions measurements were made in a typical installation configuration.
Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

This method refer to ANSI C63.10.
The procedure for peak unwanted emissions measurements above 1000 MHz is as follows:
Set the spectrum analyzer in the following:
9kHz~150 kHz
RBW=200Hz, VBW=1kHz/ Sweep=AUTO
150 kHz~30MHz
RBW=9KHz, VBW=30KHz,/ Sweep=AUTO
Below 1GHz
RBW=100kHz / VBW=300kHz / Sweep=AUTO
a) Peak emission levels are measured by setting the instrument as follows:
Above 1GHz
PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO
b) Average emission levels are measured by setting the instrument as follows:
Above 1GHz
AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO
c) Detector: The measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage

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averaging. Log or dB averaging shall not be used.)

e) Sweep time = auto.

f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)

g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

The test is in transmitting mode.

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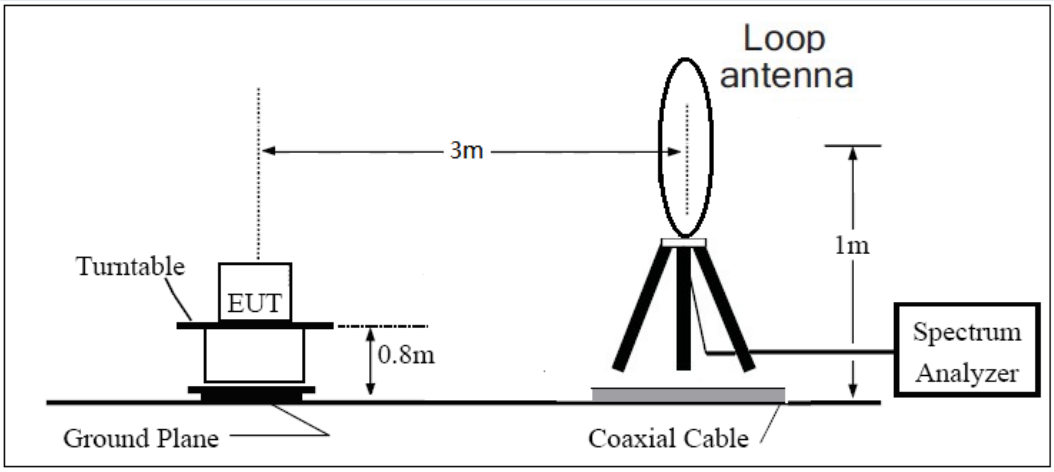
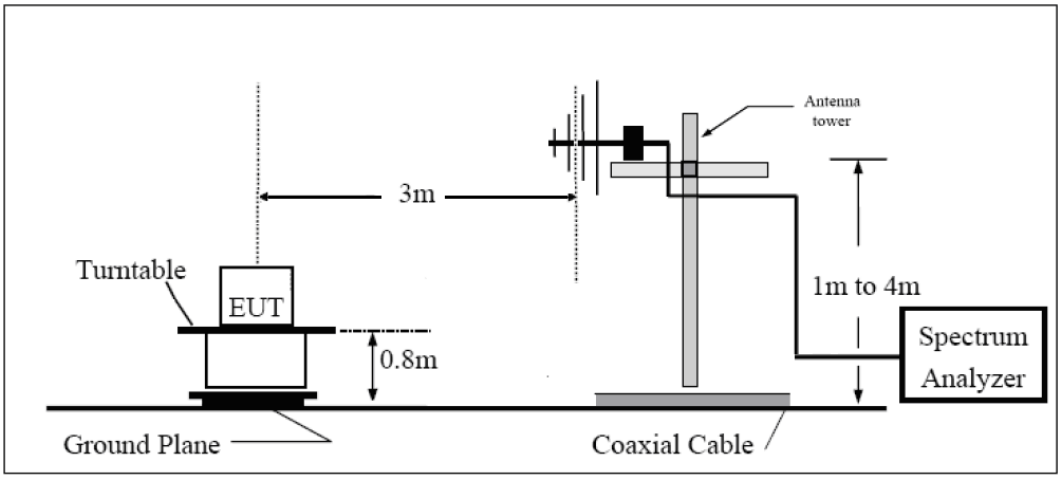
Test setup

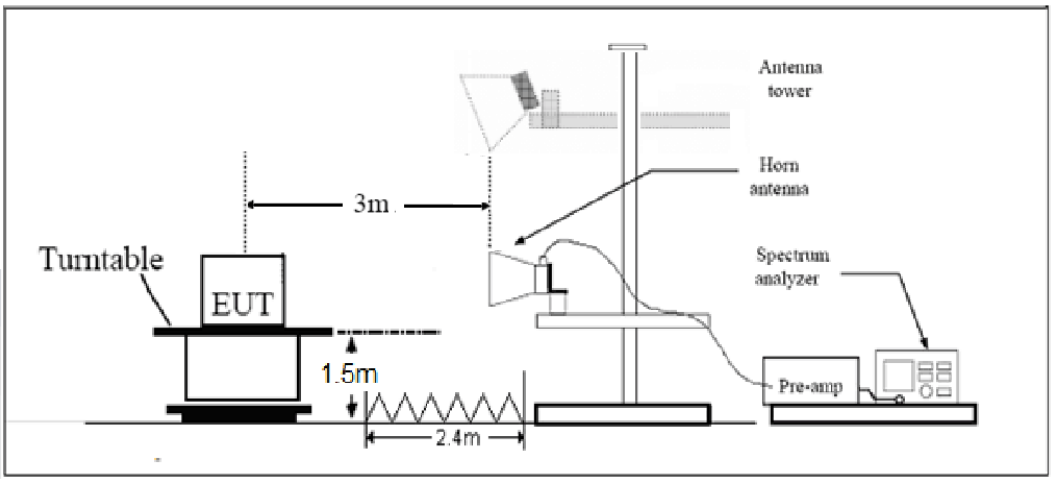
9KHz ~ 30MHz



30MHz ~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

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